2022 Michigan Heat Pump Collaborative Market Characterization

slipstream

TABLE OF CONTENTS

EXECUTIVE SUMMARY

As the State of Michigan readies itself for federal funding opportunities tied to the Infrastructure Investment and Jobs Act (IIJA) and the Inflation Reduction Act (IRA), Michigan's Investor Owned Utilities (IOUs) must also plan how energy technologies and incentives will align for the onslaught of residential customer inquiries as a result. As an early first step to understanding the market need for heat pump technologies, Consumers Energy (CE), DTE Energy (DTE), Upper Peninsula Power Company (UPPCO), and Indiana Michigan Power (I&M) joined to found the Michigan Heat Pump Collaborative (MIHPC). The purpose of MIHPC is to lead the Midwest with heat pump technology market transformation strategies. The mission of the MIHPC is to create a holistic education, outreach and training forum to pursue deeper engagement with manufacturers, distributors, trade allies, customers and other stakeholders to identify needs, remove barriers and ultimately increase adoption and participation in heat pump technologies. Based on prior information gathering, the MIHPC understands the many market barriers to heat pump adoption. They also recognize that some of the obstacles to increased heat pump market traction center on a lack of product and performance knowledge by HVAC and plumbing contractors, influencers, and end-users. To gain these competencies, MIHPC has relied on Slipstream to implement market research and a needs assessment that will inform a meaningful training regimen that gives trade allies the tools and techniques they need to succeed. The training will incorporate market-based interventions that are carefully curated by expert educators with a passion for heat pumps.

Inflation Reduction Act (IRA) funding is a catalyst to new markets for heat pump adoption. As heat pump technology gains traction in marketplaces across the United States, the MIHPC has taken important steps in ascertaining how Michiganders can benefit from potentially adding heat pumps into their decision-making processes. One significant factor in customer decision-making is the availability of information through a trusted and educated contractor network. But what are the barriers to contractor engagement with heat pump technologies in Michigan? As an educational initiative at its core, the MIHPC took the first step to educate itself on the state of the heat pump technology market. Based on research outcomes, it is clear the utilities within the collaborative, and Michigan as a whole, are at a tipping point to transform the heating and cooling market with heat pumps. Identified challenges align with many of the findings from the February 2021 Michigan Power Grid New Technologies and Business Models working group findings, such as lack of customer education, high installed costs, and limits on heat pump rebates for fuel switching.[1] As an educational initiative and forum for the exchange of utility program best practices, the MIHPC marks a significant milestone towards statewide collaboration on heat pump implementation strategy.

Taking into consideration prior research, pilot efforts, and other utility-focused work in this market, there are many key takeaways that can help set the stage for future program

[1] Further insights were outlined in the final staff report published in December 2021. https://mi-psc.force.com/sfc/servlet.shepherd/version/download/0688y000001jEwjAAE

enhancements, contractor education, and customer empowerment. All three segments need to align for heat pumps to be recognized as a viable alternative to mainstream residential HVAC systems. They include:

1. Utility programs and rebate offerings that offset the initial capital expense and higher costs of heat pump installations.
2. Contractor education on proper heat pump applications, rate navigation, and business model adaptation.
3. Customer empowerment for their decision-making processes, understanding the benefits, contractor experience, and heat pump operation once installed.

The MIHPC educational effort will extend beyond the initial four collaborative utility investors, impacting all of Michigan. Contractors tend to provide services in more than one utility service territory. Electric cooperatives and municipal utilities will also need to ensure their programs are easy to understand and participate in so that contractors can confidently provide incentive information to customers. Awareness and education campaigns will also overlap service territories, thus ensuring that the message is consistent across the state is highly important. Lastly, by working with manufacturers, distributors, workforce development entities and the various heat pump stakeholder groups across the Midwest, the MIHPC will be empowered to exchange best practices, solidly reinforce the capabilities and benefits of heat pumps through multiple channels, and will offer Michiganders sound energy choices for years to come.

INTRODUCTION

Consumers Energy, DTE Energy, Indiana Michigan Power , and Upper Peninsula Power Company have joined forces to form the Michigan Heat Pump Collaborative (MIHPC) to lead the state of Michigan with heat pump education and market transformation strategies. The mission of the MIHPC is to create a holistic education, outreach, and training forum to pursue deeper engagement with the supply chain, customers, and other stakeholders to identify needs, remove barriers and ultimately increase adoption and participation in heat pump technologies.

To create an effective statewide heat pump educational initiative, the MIHPC endeavored to characterize the state of the current market in Michigan. To achieve this goal, the MIHPC engaged with various essential market actor stakeholders across Michigan to understand current perspectives on heat pumps and barriers to adoption. We also characterized space heating fuel concentrations, rates, and recent heat pump sales, programs, and pilots within Michigan and in a sample of neighboring states and Northeast states with nation-leading heat pump programs.

The primary focus of the MIHPC is on single-family and multifamily residential heat pump opportunities with consideration of customers of all income levels. Findings will directly impact utility Energy Waste Reduction programs and MIHPC's development of an educational hub and contractor heat pump designation. Research findings will also illuminate the pathway to a broader set of market interventions that could help accelerate the development of the Michigan heat pump market.

STATE OF THE MICHIGAN HEAT PUMP MARKET

BENCHMARKING MICHIGAN'S RESIDENTIAL HVAC SALES

To understand historical trends of the heat pump market in Michigan and neighboring states, we analyzed data provided by the Heating Air-conditioning and Refrigeration Distributors International (HARDI) Unitary Market Report for calendar years 2013 to 2021[2]. The HARDI report includes monthly estimates for unit sales for air-conditioning (AC) units, air-source heat pumps (ASHP), and furnaces at the state level. The state-level data is only provided for states where HARDI partnerships provide significant market coverage. HARDI defines this data threshold as having no fewer than three wholesale distributors selling in the state, which should cover at least 75% of the state's total market. It is important to note while the number of participating distributors in the HARDI reporting program varies year to year, the estimates reflect actual market conditions in each state at any given year. They are not a direct duplication of actual distributor sales totals.

[2] Data obtained from Unity Market Report (2022) prepared by HARDI under data license by HARDO. Reuse is prohibited without permission. All rights reserved.

Figure 1 below compares Michigan's annual AC, ASHP, and furnace sales estimates from 2013-2021. ASHP sales have consistently increased over the past decade, but the number of ASHP units still lags behind conventional residential HVAC equipment sales. From 2013-2021, ASHP sales in Michigan increased by more than 330%, significantly higher growth than AC units (133%) and furnaces (59%). The change in ASHP sales in Michigan has accelerated to the point that in 2021, ASHP sales were more than double the total sales in the previous year (a 123% increase year over year compared to 26% for ACs and 15% for furnaces). A possible explanation for Michigan's strong ASHP sales growth is that the state uses more propane in the residential sector than any other state. The rapid growth of heat pump sales in 2021 may be partially due to the significant increase in propane prices throughout the year and increased utility heat pump pilot activities.

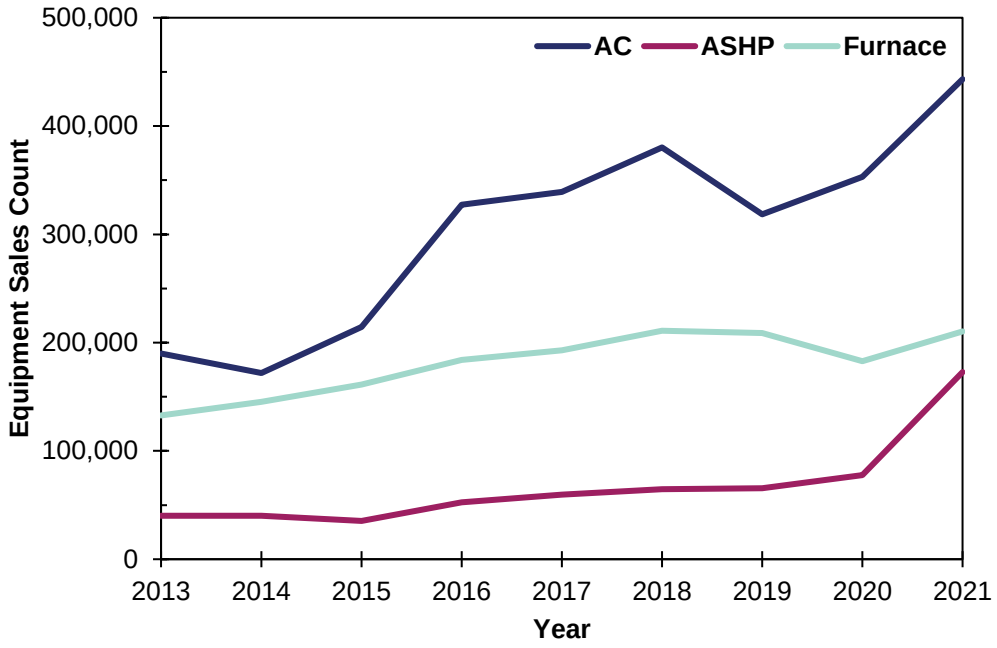

Figure 1. Annual HVAC equipment sales in Michigan from 2013 to 2021 (Data obtained from Unity Market Report (2022) prepared by HARDI under data license by HARDI. Reuse is prohibited without permission. All rights reserved.)

In Figure 2, we compare the growth in ASHP sales in Michigan to that of other states and nationwide HVACR shipment data provided by the Air-Conditioning, Heating, and Refrigeration Institute (AHRI)[3]. Unlike HARDI, the AHRI statistics are U.S.-manufactured shipments of central air conditioning, air-source heat pump systems, and gas and oil furnaces. This suggests that the nationwide AHRI data reflects stocking orders rather than customer shipments. Overall, in terms of ASHP sales growth, Michigan is the leading state amongst the Midwest states we analyzed. Compared to national-level data, the increase in ASHP sales in Michigan (330%) is more than triple what the AHRI data suggests for the nation overall (99%). However, comparing Michigan's ASHP sales with AC and furnace sales indicates that Michigan can still grow its relative ASHP

[3] https://www.ahrinet.org/analytics/statistics/historical-data

market share. An excellent example is the state of Massachusetts, where furnace sales are down 21% compared to 2013, and AC sales have only increased 14% over the past decade.

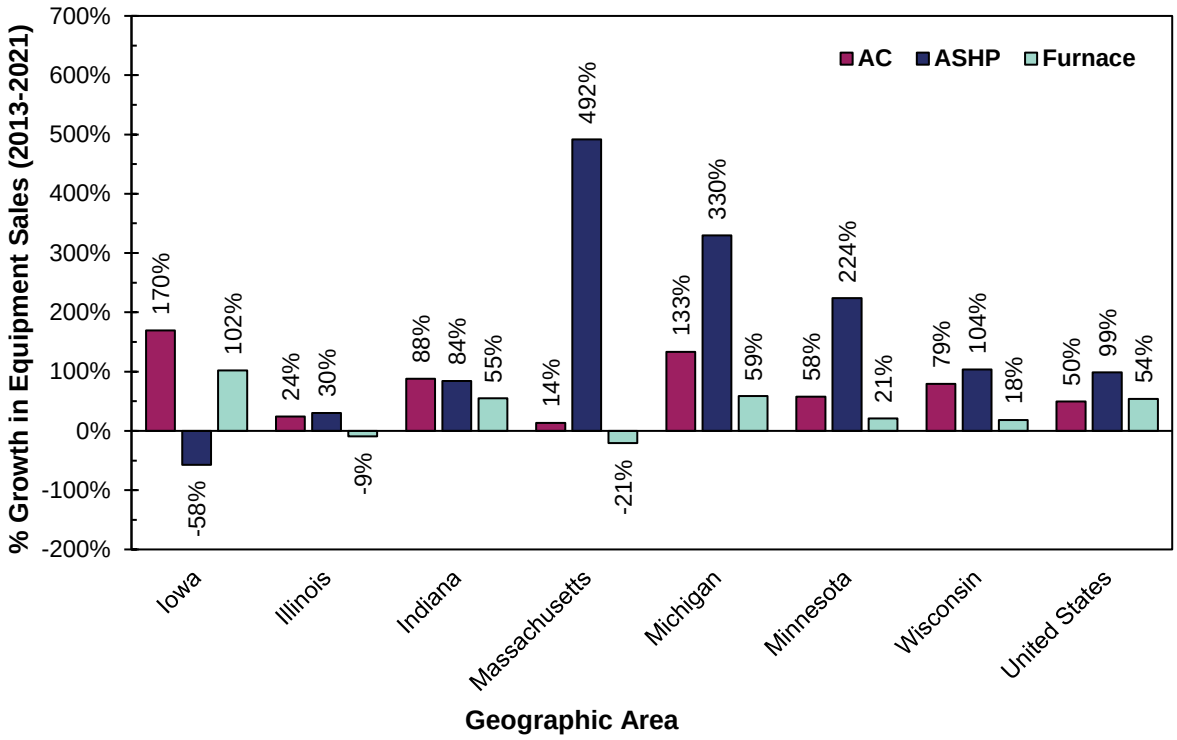

Figure 2. Growth in HVAC equipment sales from 2013 to 2021 (Data obtained from Unity Market Report (2022) prepared by HARDI under data license by HARDI. Reuse is prohibited without permission. All rights reserved.)

In 2021, Michigan had the highest number of ASHP unit sales in the Midwest—by the total number of annual units sold and per capita normalized sales, as presented in Table 1 and and Figure 3. This provides a promising outlook for Michigan's ASHP market momentum, especially when considering states like Illinois, with a similar climate and a larger population. Illinois has historically had lower levels of ASHP sales overall and per capita.

Table 1. Number of annual ASHP sales, building permits, and total population by state in 2021.

State	Total Population (2021)[14]	Number of New Housing Units (2021)[5]	Approximate Number of ASHP Sales (2021)[6,7]
Michigan	10.07 Million	16,554	173,000
Illinois	12.79 Million	11,036	40,000
Massachusetts	7.02 Million	15,465	35,000
Wisconsin	5.89 Million	17,898	33,000
Minnesota	5.71 Million	25,427	44,000
Indiana	3.79 Million	22,363	33,000
Iowa	3.19 Million	10,927	2,000

ASHP sales, when normalized against U.S. Census 2021 state-level housing units estimates, show that Michigan is the only state with a significant sales growth over the last decade (Figure 3). In 2013, approximately nine ASHP sales were associated with every 1,000 Michigan housing units. In 2021, that figure increased to nearly 40 annual ASHP sales per 1,000 housing units, more than four times the 2013 values. Population-normalized data also suggested similar conclusions.

[4] US Census Bureau. (2022a). *State Population Totals and Components of Change: 2020-2021*. https://www2.census.gov/programs-surveys/popest/tables/2020-2021/state/totals/NST-EST2021-POP.xlsx (Accessed October 10, 2022)
[5] US Census Bureau. (2022b). *National and State Housing Unit Estimates: 2020 to 2021*. https://www2.census.gov/programs-surveys/popest/tables/2020-2021/housing/totals/NST-EST2021-HU-ANNCHG.xlsx (Accessed October 10, 2022)
[6]Data obtained from Unity Market Report (2022) prepared by HARDI under data license by HARDI. Reuse is prohibited without permission. All rights reserved.
[7] HARDI estimates were rounded to protect data privacy.

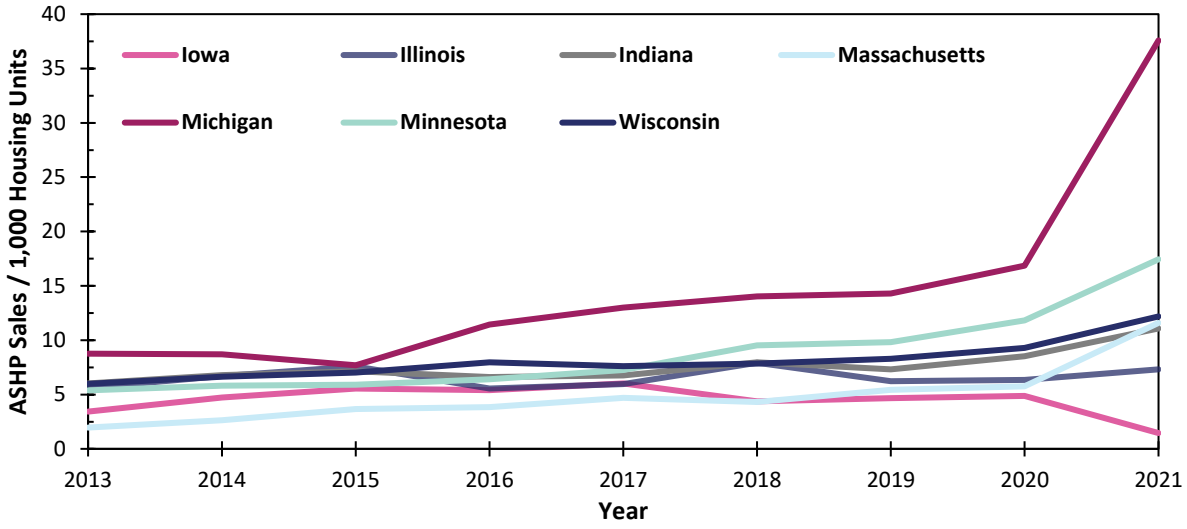

Figure 3. Changes in housing normalized ASHP sales by state from 2013 to 2021 (Data obtained from Unity Market Report (2022) prepared by HARDI under data license by HARDI. Reuse is prohibited without permission. All rights reserved.)

Figure 4 displays a clear historical trend in the efficiency levels of the ASHP units sold in Michigan. The SEER ratings are based on the nominal compressor rating, not on the rating for an AHRI combination of indoor and outdoor units.[8] The relative number of high-efficiency ASHPs sold with a Seasonal Energy Efficiency Ratio (SEER) rating of 20 and above has increased over the past decade. In 2021, 36% of all ASHPs sold in Michigan had a SEER rating of 20 or above. Lower efficiency SEER 13 units were phased out after 2016 as the federal minimum efficiency standards increased in 2015. This was the first time northern and southern states had different efficiency requirements for ASHPs. This phaseout coincided with a rise in the minimum ENERGY STAR efficiency for AC in northern states where the new minimum was 14.5 and ASHP minimum nationally raised to 15.5 SEER. As a part of the northern states, Michigan could sell ASHP equipment below 15.5 SEER.

[8] Note that HARDI does not report heating seasonal factor (HSPF)

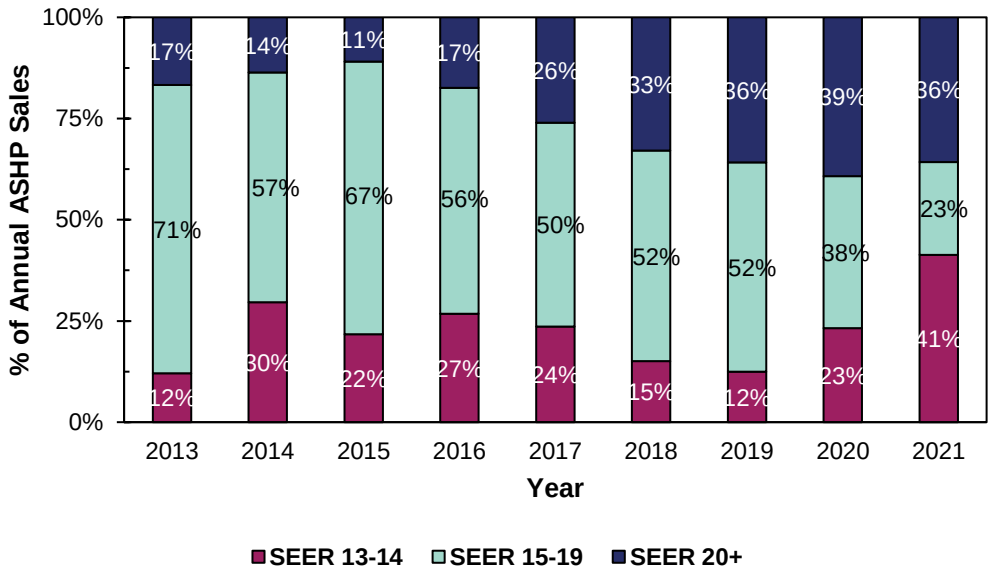

Figure 4. Efficiency of ASHPs sold in Michigan from 2013 to 2021 (Data obtained from Unity Market Report (2022) prepared by HARDI under data license by HARDI. Reuse is prohibited without permission. All rights reserved.)

Figure 5 shows how the share of ductless versus ducted ASHP units sold in Michigan changed over time. In 2021, there was an even balance between the number of ASHP sales for ducted and ductless units.

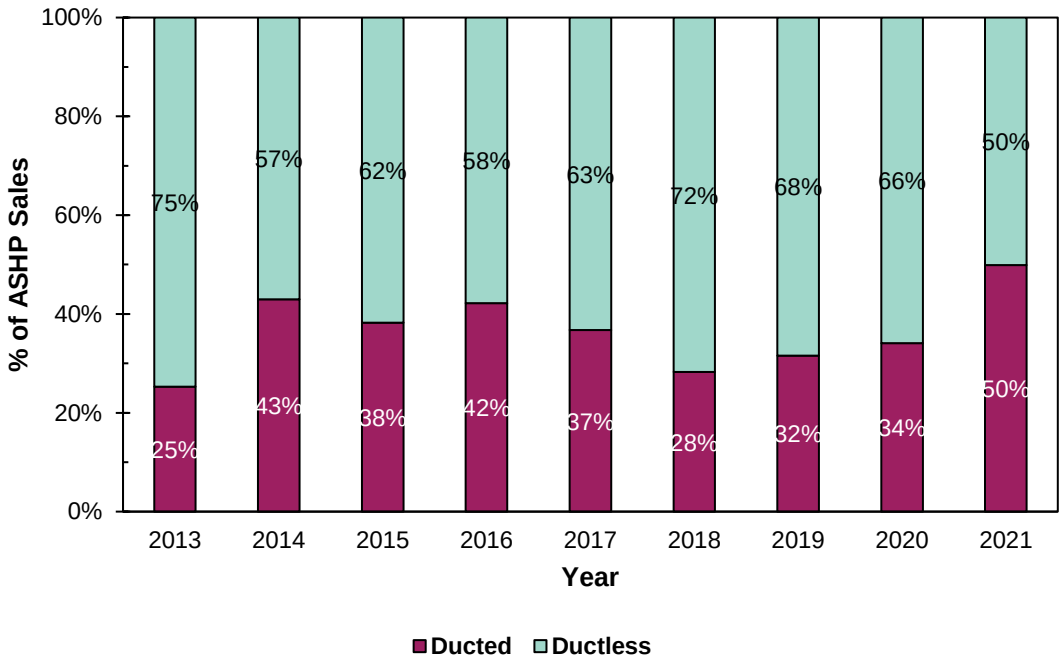

Figure 5. Ducting type of ASHPs sold in Michigan from 2013 to 2021 (Data obtained from Unity Market Report (2022) prepared by HARDI under data license by HARDI. Reuse is prohibited without permission. All rights reserved.)

A closer look at the capacities of HVAC equipment sold in Michigan in 2021 (Figure 6), suggests that heat pumps are sized to meet the cooling load or sized for partial heating displacement. Most systems fall within 15 to 19 SEER and may include single and two-speed heat pumps and select multi-speed and inverter-driven heat pumps from select manufacturers. Low stage can meet summer cooling needs and high stage can meet partial displacement of heating. Based on the capacities, we expect these heat pumps could cover a significant portion of the home's heating load. It should be noted that the residential AC and heat pump capacity is limited to 65,000 BTU/hr or less, whereas furnaces sized larger are included.

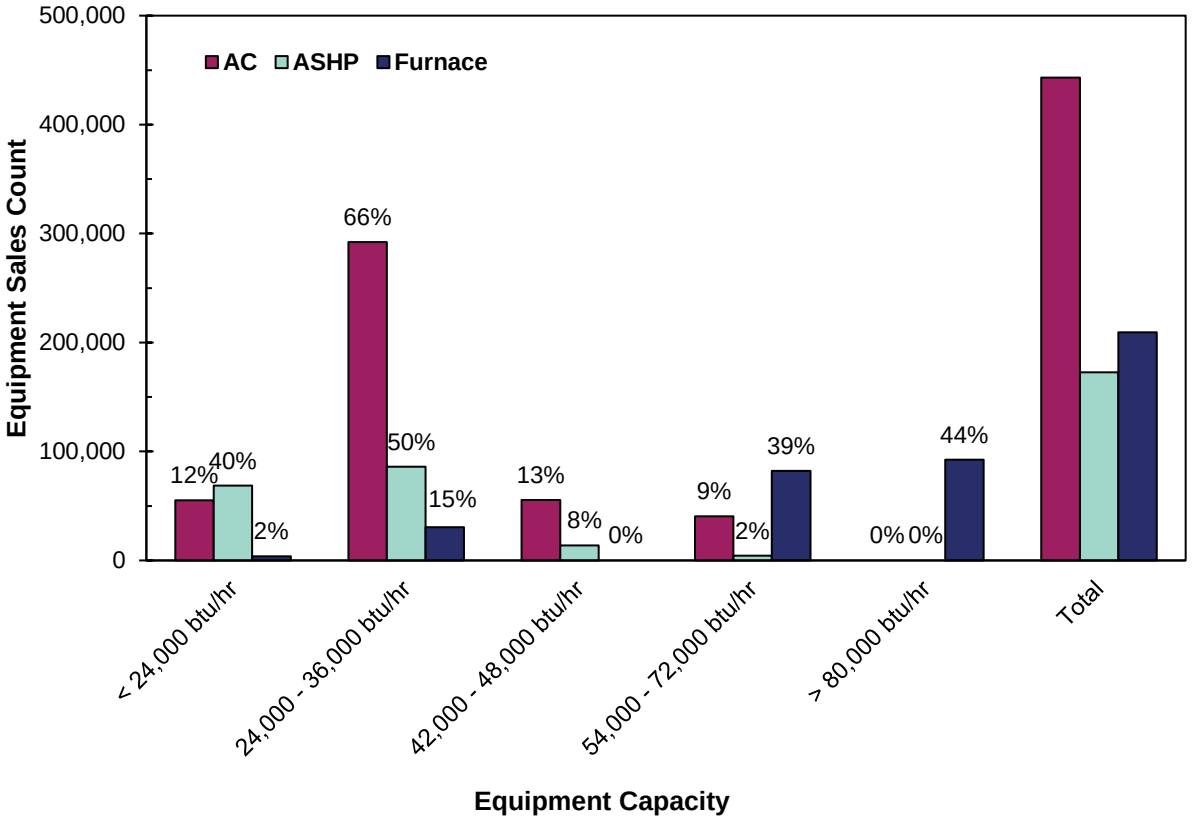

Figure 6. Capacity of HVAC equipment sold in Michigan from 2013 to 2021 (Data obtained from Unity Market Report (2022) prepared by HARDI under data license by HARDI. Reuse is prohibited without permission. All rights reserved.)

Figure 7 and Figure 8 below compare the capacity of ASHPs sold in Michigan over the years based on their ducting type. The data shows the majority of ductless ASHPs (between 47% to 69% depending on the year) sold in Michigan were 24,000 BTU/hr or lower. Most ducted ASHP units sold over the years have had a capacity between 24,000 BTU/hr to 36,000 BTU/hr. While there is a considerable number of higher capacity ducted ASHP units (42,000 BTU/hr or more) sold in market, the same cannot be said for ductless ASHP units. The lower capacity ductless heat pumps are likely providing zonal heating and cooling solutions. Ductless heat pumps at or below 24,000 BTU/hr would be capable of meeting full heating and cooling loads of a portion of a home. However, the central systems can serve the full home cooling needs and a significant portion of the heating needs. The larger capacity systems in both ducted and ductless are likely

sized to significantly reduce a home's dependence on delivered fuel or electric resistance heat. Purchases of these units happened in greater percentages following the 2014 propane price spikes.

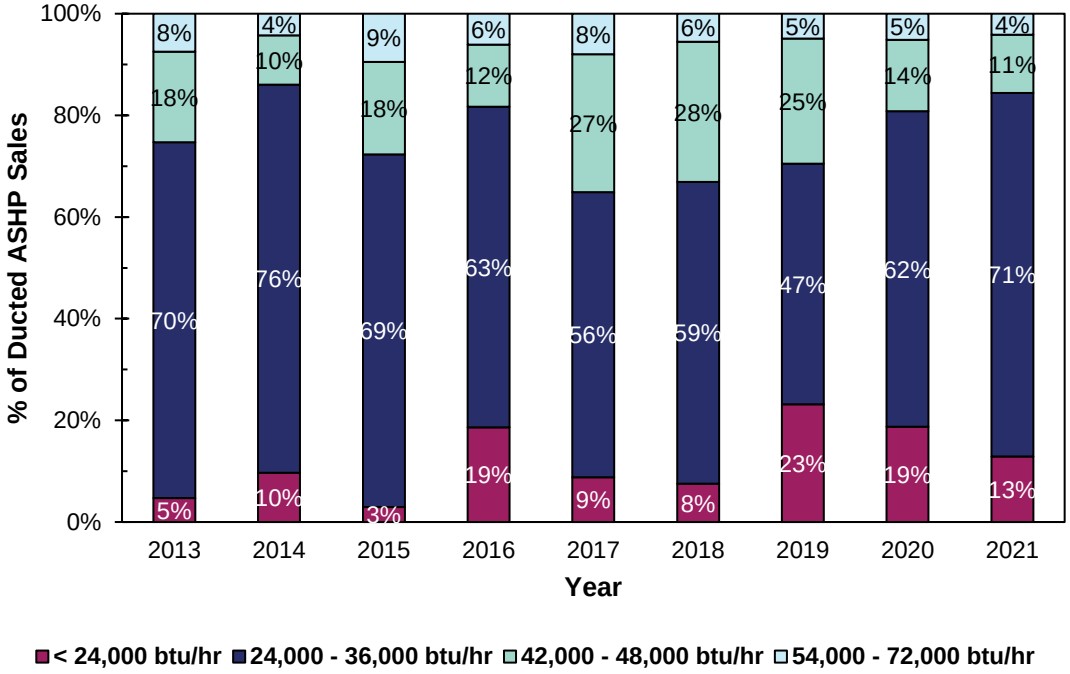

Figure 7. Capacity of ducted ASHPs sold in Michigan from 2013 to 2021 (Data obtained from Unity Market Report (2022) prepared by HARDI under data license by HARDI. Reuse is prohibited without permission. All rights reserved.)

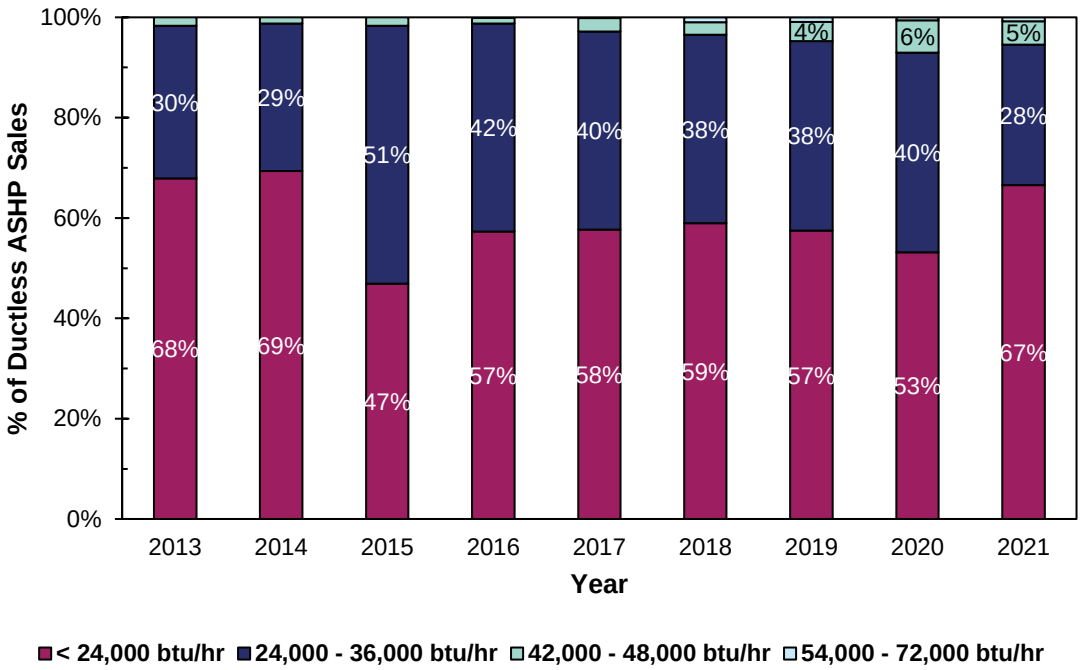

Figure 8. Capacity of ductless ASHPs sold in Michigan from 2013 to 2021 (Data obtained from Unity Market Report (2022) prepared by HARDI under data license by HARDI. Reuse is prohibited without permission. All rights reserved.)

To continue tracking ASHP market progress, ongoing monitoring of Michigan heat pump sales data could be beneficial. Manufacturer and distributor partners are likely to be the best source for heat pump sales insights that are timely and locally relevant. More detailed heat pump installation data can be tracked and aggregated from utility and other local and state incentive programs.

COMPLETED RESIDENTIAL MICHIGAN HEAT PUMP RESEARCH

2020-2021 Consumers Energy Cold-Climate Heat Pump Initiatives

Consumers Energy conducted multiple heat pump pilot initiatives from 2020-2021 as part of its approved EWR Plan. All initiatives were implemented through Consumers Energy's existing residential, income-qualified single-family, income-qualified multifamily, small-business, or pilot program offerings.

Income-qualified multifamily participants with electric heating were a primary target customer segment. While fuel switching is not allowed under Energy Waste Reduction (EWR), in the original scope market-rate and income-qualified single-family customers with delivered fuel

heating were also eligible for participation. Delivered fuels in Michigan include propane, fuel oil, and wood/biomass. It should be noted that after the 2014 price spikes, Michigan was in a prolonged period of low propane prices that had not climbed over $2.00 a gallon until January 2021. In addition, parts of Consumer Energy's electric territory are in areas of recent natural gas service territory expansion, which has led to a shrinking addressable market for propane displacement or replacement with heat pumps. In March of 2021, only customers with electric heating were eligible for participation in all programs.

The impact evaluation will complete in 2022 as a late start and slow participation delayed the evaluation. Heat pumps installed for market-rate and income-qualified single-family and income-qualified multifamily customers will be evaluated by engineering analysis, and heat pumps for small commercial customers will be evaluated by metering analysis.

The goal of the settlement was to demonstrate the potential for energy savings by replacing inefficient heating and cooling equipment with CCHPs. The settlement agreement defines a qualifying cold-climate heat pump as a ground source or air source heat pump that can:

- Produce full nameplate heating capacity at 5 degrees F[9]
- Have a COP of at least 1.75

The initiative allows the existing heating system to remain as a backup so long as at least 50% of the heating load from existing fuel use is displaced. It is worth noting that while cold-climate heat pumps were required for this initiative, a 50% displacement or more in delivered heating fuels can be achieved with even simple single and two-stage air source heat pumps. There is also an add-on ENERGY STAR®-rated ground source heat pump (Well-Connect®) manufactured in Michigan that can reduce up to 90% of a home's delivered fuel use. The benefit of these systems is that the upfront product cost is significantly lower. In a dual fuel scenario, it is unnecessary to have a heat pump operating at five degrees as the propane system typically functions at temperatures below 20-30F. Residential eligibility was limited to primary full-time residences only—excluding secondary or vacation homes.

Consumers Energy Market Rate Residential Pilot

After collecting insight from contractors, the residential market rate pilot opted to offer $1,000 for NEEP-listed cold-climate heat pumps. The use of the cold-climate heat pump list from NEEP was an easy way to ensure low-temperature COP requirements were met. However, the displacement requirement changed during the process of program implementation. Program documents require that at least 50% of the heating load be displaced based on a ***whole-home heating load estimation,*** not ***baseline electricity or delivered fuel consumption***. During the MIHPC stakeholder needs assessment, a large trade ally noted the issue and discontinued program participation due to the difficult qualification criteria.

The heat pump sizing requirement that was implemented differs from what was discussed when initially recruiting contractors and significantly impacts the sizing of a centrally ducted heat

[9] We assume nameplate heating capacity is rated heating capacity at 47F

pump. The table below highlights heat pump and furnace capacity for six complete dual fuel systems with propane backup field monitored in Great Lakes Energy service territory. As shown, 50% reduction in propane is possible when a heat pump is sized for the home's cooling load, which is less than 50% of the furnace capacity. The table highlights the importance of switchover temperature as a better indicator of propane reduction than cold-temperature heat pump capacity or efficiency. Focusing pilot heat pump qualifications on energy reduction could have helped expand access to systems sized for the customer's need and within their budget.

Table 2 Heat pump and furnace capacity for six complete dual fuel systems with propane backup field monitored in Great Lakes Energy service territory.

Switchover Temperature	Heat Pump Cooling Capacity (95°F)	Heat Pump Heating Capacity (47°F and 17°F)		Furnace Capacity	% of heat heating pump capacity (47°F) vs furnace	Propane Reduction
20°F	34,600	32,200	26,400	80,000	40%	64%
25°F	34,800	31,600	20,200	88,000	36%	50%
30°F[10]	24,200	21,400	16,900	60,000	36%	41%
28°F	23,000	24,000	16,100	60,000	40%	43%
20°F	36,000	34,200	22,400	80,000	43%	34%
25°F	28,000	28,200	16,800	80,000	35%	63%

Consumers Energy's pilot launched in 2020 during the onset of the COVID-19 pandemic and faced challenges, including a delayed start in the fall of 2020. The delay was unfortunate as customers seeking heat pumps to offset propane prices are typically installed in the spring and summer when the contractors are also selling and maintaining air-conditioners. Overall, the market-rate pilot experienced challenges enrolling participants. Midway through, the initiative changed the goal from 100 homes to 50 homes. The stricter sizing requirement, COVID-19-related issues such as apprehension to home visits and large expenses, limited contractor participation, and low propane prices may have contributed to lack of participation. Geographic targets included areas outside of major cities such as Grand Rapids and Kalamazoo, east towards Muskegon, and eventual expansion to east side of the thumb in places like Flint and north of Lansing. The 10 northern most counties in Consumers Energy electric service area were not included.

Overall, the pilot evaluation revealed high satisfaction from customer participants when stating their satisfaction with the overall experience and likelihood of recommending heat pumps to a friend. Out of the nine participants surveyed, most were previously aware of a heat pump before making the purchasing decision, and this awareness was typically derived from their contractor.

[10] Unit on this row is on NEEP's cold-climate heat pump qualification list

The MIHPC stakeholder investigation revealed additional market actor feedback on this pilot. These are a limited set of findings from select market actors nearly a year after completion of the program so caution in interpretation is encouraged as recollections may differ. First, distributors and contractors thought the $1,000 incentive was appropriate for the equipment prices at the time of pilot implementation. Second, the HVAC market values consistency and is tuned to program eligibility requirements and barriers. The Consumers Energy standard residential HVAC program has a 10-year history of only allowing heat pump rebates when replacing existing heat pumps or electric heat. To drive deeper participation, the pilot would have needed to expand marketing to new contractors, trade allies who were inactive or removed for inactivity, and heavily promote the change in eligibility restrictions to distributors. Seasoned market actors suggested that it may have been better to keep the program going until 100 heat pumps were reached as the time constraint was listed as a challenge. Finally, during the pilot period, two of the largest mini-split manufacturers (Daikin and Fujitsu) experienced significant shipping delays, which weren't reflected in the equipment brands sold by distributors participating in pilot interviews. Two of the largest HVAC distributors (Johnstone Supply and Williams Distributing) were also not interviewed. As discovered in stakeholder interviews, outreach to additional manufacturers and distributors would have helped ensure the supply chain was better prepared to deliver on residential customer demand and expand the pool of potential contractors and participants.

Upon completion of 53 projects, this pilot ended, and Consumers Energy has devoted increased attention toward heat pump market transformation through efforts such as the DOE heat pump challenge and the MIHPC and emerging heat pump technologies and applications.

Consumers Energy Income Qualified Single Family Pilot

Consumers Energy's low-income single-family pilot was larger-scale and ultimately installed 179 systems from 2020-2021. Both centrally ducted and ductless ASHPs and two Well-Connect ground-source systems were installed. The full heat pump installation cost was covered and averaged around $16,000. Participants for the income-qualified single-family pilot were recruited through select contractors that were participating in the income-qualified standard program. A few initial participants did not have central heating systems in working condition. In these cases, customers were provided with all-electric heating systems, and the failed propane or oil furnace was removed and replaced with an electric air handler or ductless units.

Customers converted to all-electric heat pump systems from propane furnaces experienced costly energy bills. The cost per million BTU illustrated in Table 3 below suggests that homes were converted to a more expensive heating fuel, given the low propane price.

Table 3 Cost per million BTU for heating equipment

Heating equipment and fuel cost	Cost Per Million BTUs
Propane furnace 80% AFUE, $1.75 per gallon	$23.95
ASHP with 2.0 COP, $0.175 per kwh	$25.64
Electric resistance heat, $0.175 per kwh	$51.29

While participants reported improved comfort, operational costs were a significant challenge. In some cases, high-efficiency propane furnaces were later installed when participants escalated concerns with their new all-electric systems. To avoid this issue of high operational costs for all-electric heat pumps replacing oil or propane systems, the program changed heat pump equipment and baseline fuel type eligibility requirements[11]. Initially, delivered fuel heating systems were suspended from eligibility and then a new requirement that participants have a propane or oil system that is less than 10 years old for furnaces and less than 15 years old for boilers was enacted. As of March 2021, a change was made to no longer install heat pumps in homes with propane and instead only target homes with electric baseboard.

The program encouraged using smart thermostats designed for 24-volt controlled furnaces and AC for inverter-driven heat pumps. While all manufacturers produce a third-party thermostat interface for use with smart thermostats such as Ecobee or Nest, it is not recommended that these be used over native controls. In the case of some of the ductless systems, the manufacturer's proprietary thermostat or remote should have been used. The use of the native controls would have reduced room for error in system setup and reduced the cost. As the third-party thermostat and third-party thermostat interface are required on each indoor unit; cost was amplified even though the third-party thermostat provided no discernible value besides elimination of the need for mini-split remotes. Typically, third-party thermostats like Ecobee are reserved for use on a system with furnace backup to enable demand response or a dynamic electric rate.

Limited availability of heat pump equipment in 2020-2021 was an additional challenge. This required contractors to experience higher learning curves to properly adapt to new brands of equipment.

Since the settlement only required displacement of 50% of delivered fuels, sizing heat pumps for the home's cooling load can realize significant displacement. If systems with propane heating are intended to be served by heat pumps, other options are more commonly available than full system electrification or the use of NEEP qualified cold-climate heat pumps. Broadening the eligible heat pump specification could help expand the addressable set of homes, minimize installation and operational costs, reduced the number of indoor units, and achieve more cost-effective energy savings.

DTE residential heat pump breakeven analysis[12]

In 2021, on behalf of DTE's EWR pilots research team, Guidehouse conducted an analysis on the lifecycle cost and lifecycle emissions breakeven points for residential heat pumps installed in Michigan. A variety of residential building prototypes, baseline fuel types, and heat pump efficiencies were modeled. Forecasts for a variety of grid electricity emissions factors, fossil fuel prices, and electric prices were also included. The intent for this research was to serve as an

[11] NEEP cold-climate heat pump list cooling efficiency requirement is 15 SEER and the program increased cooling efficiency requirement to 17 SEER. This change limited the number of eligible dual fuel systems.

[12] Research results were presented to the EWR Collaborative on March 15, 2022. https://www.michigan.gov/mpsc/-/media/Project/Websites/mpsc/workgroups/EWR_Collaborative/2022/DTE-HP-Breakeven-Analysis.pdf?rev=36d0a18da7cd4b93833f76629655f42b&hash=D5A55F0F12D0C331AFDFECA41798909B

educational resource for DTE and the driver was to better understand heat pumps as a potential source for DTE to drive down emissions and help meet decarbonization goals in the State.

Many of the forecasts impacting the analysis were based on data from the Energy Information Administration (EIA). Guidehouse cautioned that forecasts of installation cost, future prices, and emissions are highly uncertain. Lower available rates such as the interruptible space conditioning (CoolCurrents rate) or wintertime-of-use rate, which are approximately $.04/kWh lower, were not modeled. With those caveats, below are a few primary findings:

- Central cold-climate heat pumps have lower lifecycle costs than oil, propane, and electric resistance heating and costs break even in four to nine years. Central cold-climate heat pumps have higher lifecycle costs than gas furnaces and boilers.
    - Operating cost breakeven price of gas is $12-$16 per MCF and lifetime cost breakeven of gas is $19-$22 per MCF. These prices are substantially higher than the base value of $8.68 per MCF.
    - Upfront cost differences are largely responsible for the lower lifecycle cost of a gas furnace/AC system compared to a central cold-climate heat pump. Heat pump installed costs can range by about $8,500 depending on whether electric upgrades are needed, and gas pipeline costs can be avoided for new construction.
- Heat pump water heaters break even with propane and electric resistance water heaters within three years whereas they do not breakeven with gas water heaters. The lifecycle cost difference between gas water heaters and heat pump water heaters is around $2,000.
- Under current and forecasted rates, for cold-climate heat pumps and heat pump water heaters to break even in terms of customer economics, upfront costs would likely need to be substantially less than gas counterparts due to the wide gap in operating costs.

Overall, this study highlights how heat pumps installed today can make a significant impact in reducing greenhouse gas emissions in Michigan. Using DTE electric emissions targets, all types of heat pumps break-even with gas appliances in two years or less. Depending on where a home is in the state of Michigan, the heating load changes, but cost and emissions breakeven points don’t change much. While electric resistance and propane heated homes represent the best economic opportunity, customer incentives to close the upfront cost gap and lower electric rates can further strengthen the economics. Inflation Reduction Act rebates and tax credits which have emerged since completion of this analysis further strengthen the value proposition for heat pumps serving space and water heating.

DTE Income Qualified Residential and Multifamily Whole-Home Mini-Split Cold-Climate Heat Pump Pilot[13]

From 2020-2021, DTE conducted a pilot focused on cold-climate whole-home mini-split heat pumps for both single-family and multifamily income-qualified homes. The pilot was implemented as part of the Energy Efficiency Assistance and Multifamily Low-Income programs. In total, there were 64 participants with 20 single-family homes represented and 44 multifamily units. All multifamily units were part of the same complex with a single building owner. Sixteen of the multifamily homes were two-bedroom and 28 were one-bedroom. The heat pumps in the study were all Mitsubishi Electric hyper-heat systems and were installed by a Diamond certified contractor. Mitsubishi Electric was consulted to support the contractor with sizing. All systems were sized according to Manual J load and sizing calculation and Manual S equipment selection. All equipment and installation costs were covered by DTE and were multi-head with two indoor heads paired with a single outdoor unit. There were two primary goals of this study which were evaluated by Guidehouse. First, DTE sought to evaluate whole-home heating season energy savings compared to baseline electric baseboard heating systems. Second, DTE sought to better understand the customer experience and best practices in heat pump operation.

Determination of energy savings relied on a pre-post analysis of AMI data and some on-site monitoring for a few homes to help validate post-installed HVAC energy consumption. To characterize customer experience, researchers relied on survey instruments. The energy savings evaluated in this pilot were lower than expected. Mini-split cold-climate heat pumps reduced average heating season energy consumption by 36% and 7%, and cooling season energy consumption by 10% and 27%, for multifamily and single-family homes respectively.

Guidehouse points to several reasons why energy savings might be lower than expected. Due to the pilot taking place during a time of COVID-19, there is an expectation that occupants were at home more frequently. Also, there was a need to leave electric resistance heat in the bathrooms due to a lack of mechanism to transfer air in and out of the bathroom easily. Many occupants continued to use baseboard electric heat and some mini-split indoor heads served previously unconditioned spaces. Finally, there was evidence some customers changed behavior such as raising the thermostat setpoint.

Guidehouse cited the use of two indoor heads paired with one outdoor unit as another possible reason for lower savings. Supporting this hypothesis, a 2020 study in Northern Illinois on 80 ductless heat pumps in income-eligible low-rise multifamily buildings with existing electric resistance baseboard found that a single-head system averaged a coefficient of performance (COP) of 2.63, whereas systems with multiple indoor heads averaged a COP of 1.47.[14] We generally recommend two separate single-zone systems as the most energy efficient solution but when it comes to meeting electrical panel limitations and outdoor unit placement constraints,

[13] Pilot results were presented to the EWR Collaborative on March 15, 2022. https://www.michigan.gov/mpsc/-/media/Project/Websites/mpsc/workgroups/EWR_Collaborative/2022/DTE-IQ-Heat-Pump-Pilot-Copy.pdf?rev=8a9de888a44c4ba184a4a0816a78cee2&hash=9252AC767455D2A0CD6E6FEF884282AC

[14] https://www.comedemergingtech.com/project/ductless-heat-pumps

multizone systems can offer better value. To maximize comfort and savings with a multizone system, customer education is important.

For single-family installations, more work was required than expected in for ducted indoor unit installation, panel upgrades, and envelope which added to the cost and complexity of installations. In addition, there was no cost-effective way of integrating controls for baseboard heating with the heat pumps. For multifamily installs, baseboard electric heat was disabled at the electric panel, but electric baseboard remained enabled for single-family installs. Window units were not removed for any pilot participants, but they were advised to use the mini-split heat pump as the primary cooling technology.

Guidehouse evaluated customer experience through surveys and learned that residents, particularly older occupants, value the radiant heat from electric baseboard due to the direct heat it provides when positioned next to it. It is important to note that this study sample is small, and in general, Mitsubishi Electric has reported that over 90% of residential customers of all ages experience increased comfort when using their systems. Anecdotal data was collected through surveys that revealed customers significantly improved their comfort by changing thermostat setpoint behavior. Integrated controls for electric baseboard and ductless mini-splits are still complicated and can increase costs significantly. While Mitsubishi Electric can effectively integrate electric baseboard and mini-splits through its Kumo Station controls, standard Mitsubishi Electric thermostats were used for cost reasons. In the resource shared with customers on thermostat use, proper guidance was provided to “set it and forget it”. However, example literature of a thermostat programmed schedule illustrated an eight-degree setback overnight which we suspect may have caused some customer confusion and reduced energy savings potential.

One major takeaway is that customer adoption of heat pumps represents a major change in technology and contractor and customer education is necessary on how the technology should be used to meet the customer’s goals. In the case of this pilot, 14/15 single-family customers cited “saving money on their electric bill” as a motivation to participate in the pilot. Customers who weigh this motivation highest may be motivated to take electric baseboard offline. This study illustrates the importance of understanding the intent of the installation and the diversity of heat pump use that may occur. Retaining customer choice and setting proper expectations is important. Customers can be empowered by an explanation that baseboard is unnecessary in the room where the indoor units of the mini-split are located and will increase energy bills if left in place. Customers can also be empowered by an explanation of electric rate options that may lower their overall heating bill. Finally, Guidehouse mentioned that manufacturer guidance was helpful for this pilot but that contractors could benefit from guidance on how to utilize the manual J calculation and recommended an easy-to-use tool.

While this pilot focused on mini-split installations to serve the entire home, as was a lesson learned with Consumer Energy’s pilots, more cost-effective energy savings may be achieved by deploying a displacement strategy. Heat pump displacement in two or three highly occupied areas of the home such as the living room and bedrooms can have a major impact on energy reduction at a lower cost. If electric baseboard was removed in those rooms, a freed-up circuit would avoid the need to upgrade electric panels and solely entail some rewiring. Removal of unnecessary electric baseboard heating also minimizes a home’s potential peak demand.

Michigan dual fuel heat pump field study[15]

From February to September 2019, the Michigan Electric Cooperative Association (MECA) Energy Optimization Collaborative conducted a field monitoring study of eight residential dual fuel air source heat pumps. Heat pumps were market-installed between 2016-2018. About half of the systems had variable-speed compressors while others had compressors with anywhere from one to five speeds. All sites used propane as the backup fuel. The oldest home was built in 1860 and the newest home was built in 2018. The size of the homes ranged from 1,400 to 2,500 square feet.

The estimated average annual propane reduction was over 50% and participants experienced $580 savings in annual heating and cooling costs. Assuming participants would have installed both a furnace and air conditioner instead, the simple payback averaged four years. If participants would have only installed a furnace instead, the simple payback averaged 14 years. During the eight-month monitoring period, the systems saved an average of 10% greenhouse gas emissions compared to a conventional propane furnace and central air conditioner.

Unlike all-electric heat pumps which can rely on electric resistance boosters to simultaneously operate alongside the heat pump, the dual fuel heat pumps in this study had to either operate as a heat pump or “lock-out/switchover” and operate as a conventional furnace. The switchover from heat pump mode to furnace mode is a key operational parameter that requires careful attention from the contractor and customer. Most of the systems in this study had a switchover point based on outdoor air temperature which ranged from 20°F-30°F. Based on the modeled COPs, these switchover temperatures were within 5° F above or below what would be cost-equivalent based on the electric and propane price the household faced.

Defrost mode was identified and analyzed as part of this study and the average percentage of heating energy consumption that defrost mode made up was only 2.8% on average. This signals that defrost energy optimization is not a large opportunity for heat pump energy savings.

The comparison between heat pumps with variable-speed compressors and those with one or two-stage compressors was a research question of interest. Unsurprisingly, this study found that variable-speed compressors tend to achieve higher energy efficiency. However, there are plenty of other factors such as the sizing, switchover, and thermostat schedules which all impacted efficiency. Overall, all heat pump types achieved an estimated average seasonal heating COP of 3.4 and ranged from 2.7 to 3.9. Notably, the heat pump that achieved the highest estimated heating seasonal COP of 3.9 was a single-stage system.

While the focus of this study was on heat pump performance, insights on customer experience with the systems were also captured. Overall, participants were overwhelmingly satisfied with their dual fuel heat pump. Participants greatly valued the savings in heating costs as well as the flexibility to switch between fuels. The primary reported drawback was noisiness of the outdoor unit. Placement of the outdoor unit near an infrequently occupied room can avoid this issue and indeed all three participants with this complaint had outdoor units outside frequently occupied areas of the home.

[15] https://slipstreaminc.org/sites/default/files/documents/research/dual-fuel-air-source-heat-pump-pilot.pdf

Since completion of this study, standalone add-on inverter-driven dual fuel heat pumps and multizone inverter-driven dual fuel heat pumps have grown in popularity and product availability and offer increased versatility in a dual fuel application.

Michigan HPWH field study and survey

From Fall 2019 to 2020, the Michigan Electric Cooperative Association (MECA) Energy Optimization Collaborative investigated the feasibility of the latest generation of heat pump water heaters (HPWHs) in Michigan. Research objectives addressed performance, economics, and user satisfaction, and HPWH's impact on the home's space heating load.

The project included a field study of measured performance of HPWHs in nine homes and a survey of a larger group of HPWH owners — both groups drawn from MECA HPWH incentive program participants. Study participants tended to live in rural areas with water heaters installed in the basements of single-family homes without direct control of basement space temperature. Over 80% of the homes replaced a conventional electric water heater, and the rest replaced either a propane or gas water heater. HPWHs from three manufacturers (Bradford White, Rheem, and AO Smith) were represented. All had a nominal storage tank capacity of 50 gallons and Uniform Efficiency Factor (UEF) ratings between 3.39 and 3.56. The monitored sites had an average groundwater temperature of 58° F and air temperature around the HPWH averaged 63° F, which are representative of cold climate conditions. Importantly, hot water usage in this study was significantly lower than the norm. Study participants averaged 33 gallons of hot water used per day; compared to the assumption of 55 gallons that the DOE uses when rating the equipment.

The primary performance indicator used in the analysis was Field Energy Factor. Across the nine sites, the Field Energy Factor averaged 2.2 and ranged from 1.3-2.5 by site. This is lower than their UEF ratings of around 3.4. One reason for the reduced field efficiency is the field study participants' lower water usage. With low water usage, the effect of standby energy loss from the storage tank becomes a relatively larger portion of the system's total energy use. In addition, many of the studied sites preferred their HPWHs in hybrid mode, which uses inefficient electric resistance backup heat when the tank is low on hot water. Frequent activation of electric resistance backup had a significant impact on system performance. The study found evidence that the control algorithm in some HPWH models triggered backup heat more often than others. There may be opportunities to increase field performance with optimized algorithms.

Annual operating cost savings estimates were around $275 compared to a conventional electric resistance water heater. This will likely pay off over the lifetime of the equipment. The study estimated $180 of annual operating cost savings compared to a propane water heater, which could also payback during the water heater's lifetime. Based on performance models, the HPWH has similar operating costs to a natural gas water heater and is unlikely to overcome a higher operating cost. The cost-effectiveness results are sensitive to fuel prices and equipment costs.

A HPWH's compressor extracts heat from the surrounding air to heat water efficiently. This cools and dehumidifies the air near the tank. This benefits homeowners during the cooling season but could be a concern during Michigan's long winter. To address this concern, data was collected on the home's heating load to determine if the HPWH operation increases space

heating load. The study did not find a significant correlation between the heat extracted from the HPWH and the space heating load. One reason for the lack of a correlation is that the studied water heaters are installed in partially conditioned basements with the thermostat upstairs. There might be a more noticeable impact if the water heater was in the conditioned space and near the thermostat. Secondly, the energy extracted by the HPWH was generally under 5% of the space heating load. The small magnitude makes an impact difficult to detect amongst other uncontrolled factors.

To gauge customer satisfaction, the MECA Energy Optimization Collaborative surveyed 81 rebate participants in Michigan's upper and lower peninsulas. 85% of this sample of rural early adopters reported high satisfaction and no respondent was dissatisfied. Most respondents had no issue with the cooling effect from the HPWH causing discomfort and many others considered the cooling and dehumidification as a benefit rather than an inconvenience. Around 30% of respondents noticed some noise from their HPWH, which may be a larger comfort concern than the cooling effect. Homes that occupy the space around their water heaters are more likely to be inconvenienced by the noise or cooling effect. This should continue to be an installation consideration—particularly in smaller living spaces where residents are more likely to regularly occupy the space near their water heaters.

TARGETED MARKET OPPORTUNITIES

Residential heat pumps are more economically viable and eligible for EWR rebates in homes that currently use inefficient electric resistance for space or water heating. MIHPC utilities can increase heat pump adoption by focusing program efforts on these areas. The sections below characterize space and water heating fuel types across MIHPC utility service territories.

Estimates of residential space heating fuel type and its geographic distribution utilize the American Community Survey, which is preferred because it can provide robust estimates at the granular census tract level.[16] Unfortunately, the American Community Survey does not include a question on water heater fuel types. Instead, we reference NREL's 2022 ResStock housing characteristics data for residential water heater fuel type.[17] ResStock provides robust information but at larger geographies, which introduces more potential errors when refining the results to a utility territory. Service territory geographies are estimated with utility-provided zip code lists and verified with publicly available electric service territory information from the Department of Homeland Security.[18,19] Utility maps of homes without natural gas space heating and likely to have electric water heating are provided in the Appendix.

Consumers Energy

[16] We used the 5-year estimates from 2016-2020: https://www.census.gov/programs-surveys/acs
[17] The housing characteristics is available in the ResStock metadata: https://resstock.nrel.gov/datasets
[18] DTE's zip code data for electric customers included a small number of customers in Northwestern Michigan, where we do not believe there to be DTE electric customers based on publicly available shapefiles and published service territories on DTE's website. In this case, we utilized publicly available shapefile to define map boundaries.
[19] https://hifld-geoplatform.opendata.arcgis.com/datasets/geoplatform::electric-retail-service-territories-2/explore?location=39.828518%2C-105.917123%2C6.00

Table 4 reports the number and prevalence of homes with electric space and water heating in Consumers Energy territory. We did not obtain zip code data from Consumers Energy, so we relied on publicly available data for their electric service territory. The results show that natural gas is the most prevalent heating fuel, accounting for 70% of residential homes. Homes with electric space or water heating will be the best heat pump opportunities, which are 10%, and 27%, of Consumers Energy territory, respectively.

Table 4. Space and water heating fuel types of residential homes in Consumers Energy territory

	Space Heating (%)	Space Heating (count)	Water Heating (%)	Water Heating (Count)
Natural Gas	70%	1,198,244	64%	1,300,495
Electric	10%	164,179	27%	548,421
Propane	13%	216,210	8%	156,901
Wood	5%	81,454	-	-
Other	3%	58,411	1%	12,270

Figure 9 shows the geographic distribution of homes with electric space heating in Consumers Energy electric service territory. The results show areas with slightly higher prevalence of electric space heating in the southern and central parts of the state, especially near Mt. Pleasant, which is north of Lansing.

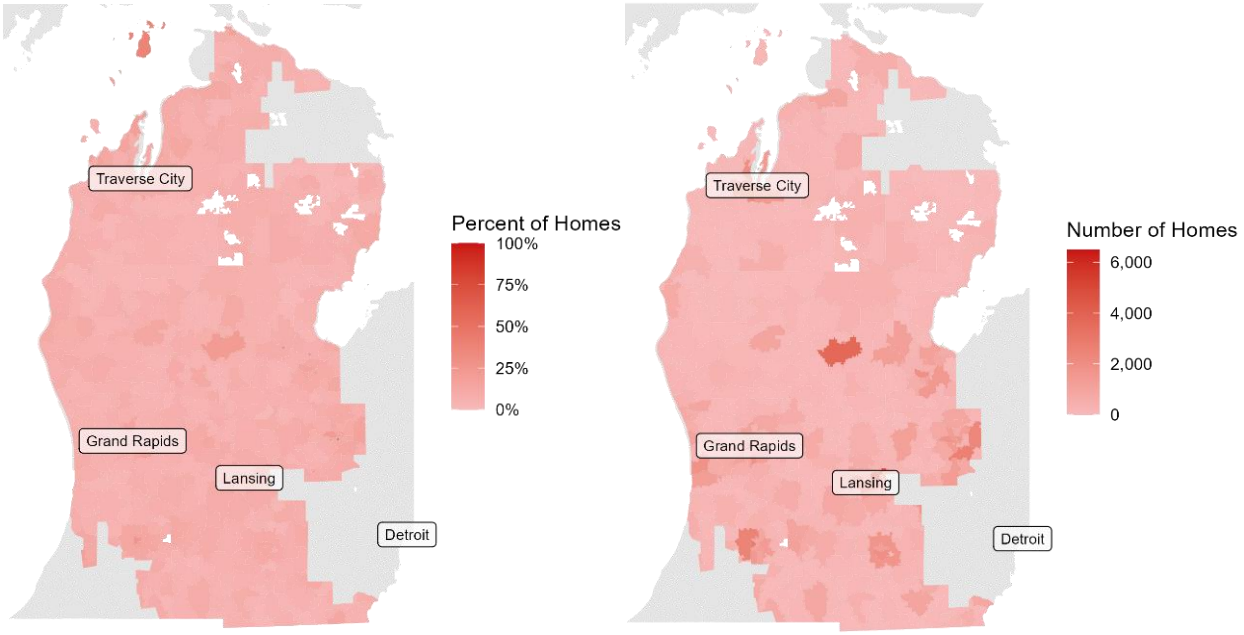

Figure 9. Prevalence (left) and number (right) of electric-heated homes in Consumers Energy service territory[20]

DTE Energy

DTE's electric service territory covers much of southeastern Michigan, including Detroit. Table 5 shows that natural gas is the most prevalent heating fuel in their electric service territory, accounting for 85% of residential homes. For those without natural gas, electricity and propane make up 10% and 3% of homes. There is an opportunity for efficient heat pump water heater upgrades for the 18% of homes DTE territory with electric water heaters.

Table 5. Space and water heating fuel types of residential homes in DTE service territory

	Space Heating (%)	Space Heating (count)	Water Heating (%)	Water Heating (Count)
Natural Gas	85%	1,791,295	80%	1,718,982
Electric	10%	203,843	18%	548,421
Propane	3%	67,469	2%	156,901
Wood	1%	16,333	-	-
Other	1%	30,188	-	-

[20] There are some known inaccuracies in the Consumers Energy service territory in these maps. For example, Beaver Island in Northwestern Michigan is not in Consumers Energy territory, but it is reported in this map. We can improve this if more granular service territory data is provided.

Figure 10 shows the geographic distribution of homes with electric space heating in DTE territory. There is a high prevalence of electric heated homes between Detroit and Ann Arbor. These may present good opportunities for heat pump replacements.

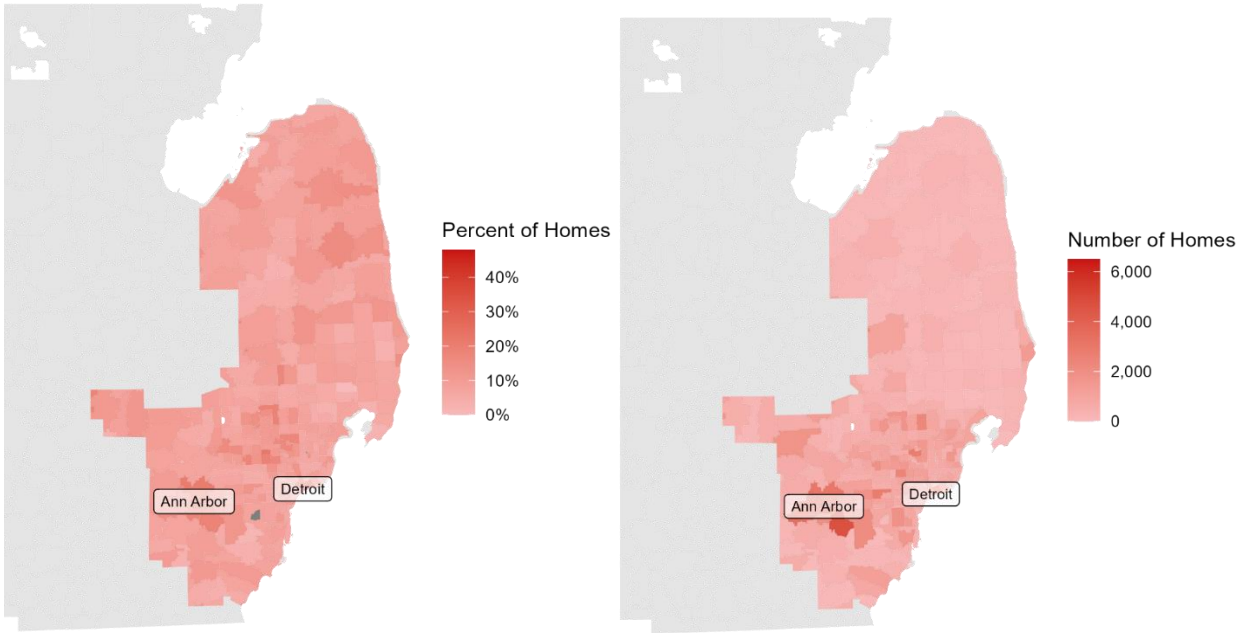

Figure 10. Prevalence (left) and number (right) of electric heated homes in DTE service territory

Indiana Michigan Power

The Michigan portion of Indiana Michigan Power's service territory covers the southwestern part of the state. Table 66 shows that 15% and 34% of homes have electric space and water heating. These are priority homes to target for heat pump installations. Indiana Michigan Power has 20% propane or wood heated homes. These customers may be more inclined to install heat pumps due to the inconveniences or expensive prices of delivered fuels.

Table 6. Space and water heating fuel types of residential homes in Indiana Michigan Power service territory

	Space Heating (%)	Space Heating (count)	Water Heating (%)	Water Heating (Count)
Natural Gas	60%	68,654	59%	66,923
Electric	15%	16,660	34%	38,846
Propane	16%	17,720	7%	7,680
Wood	4%	4,972	-	-
Other	5%	5,931	-	-

Figure 11 shows the geographic distribution of homes with electric space heating in Indiana Michigan Power service territory. There are opportunities in the southeastern part of Michigan near Niles. This would be a good place to target heat pump outreach.

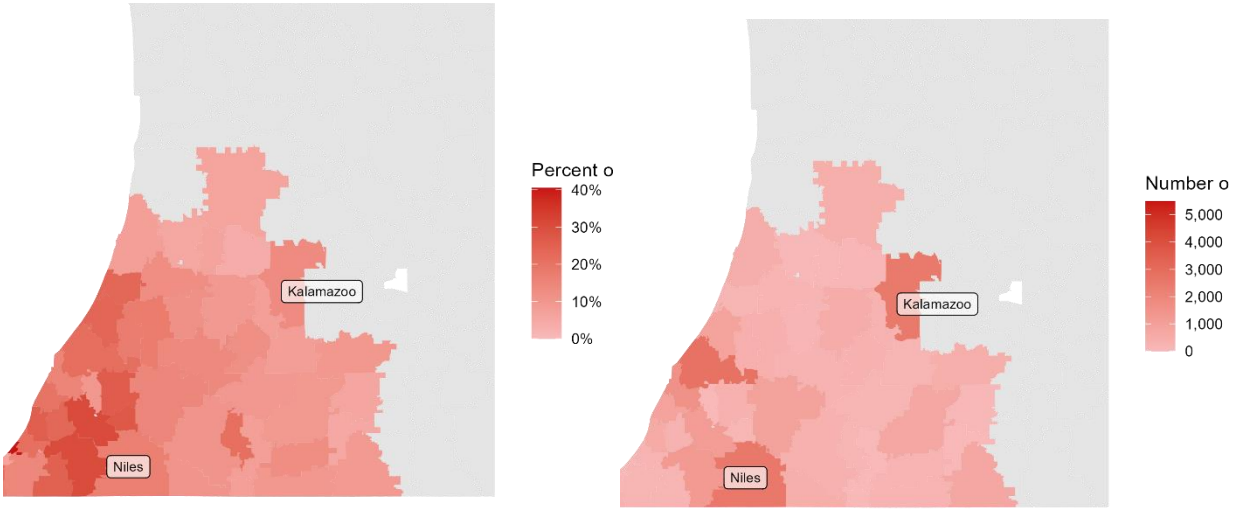

Figure 11. Prevalence (left) and number (right) of electric heated homes in Indiana Michigan Power service territory

UPPCO

Table 77 reports the space and water heater fuel type characteristics in UPPCO territory. Although natural gas is the dominant space heating fuel, it isn't as prevalent as other parts of the state and accounts for 59% of homes. Homes tend to heat with propane or wood fuels rather than electric in UPPCO territory, which is likely due to their long heating season, making electric resistance space heating very expensive. For the 9% of customers with electric space heating, heat pumps may substantially reduce heating costs.

Table 7. Space and water heating fuel types for residential homes in UPPCO service territory

	Space Heating (%)	Space Heating (count)	Water Heating (%)	Water Heating (Count)
Natural Gas	59%	29,141	56%	27,310
Electric	9%	4,254	33%	16,278
Propane	19%	9,334	10%	4,826
Wood	9%	4,355	-	-
Other	4%	1,965	1%	653

Geographically, homes heating with electricity are spread widely through the service territory. The census data shows the highest prevalence and number of electric heated homes are outside the Marquette area. Areas near the Hiawatha National Forest west of Escanaba have a high prevalence of electric heating but a smaller number of electric homes.

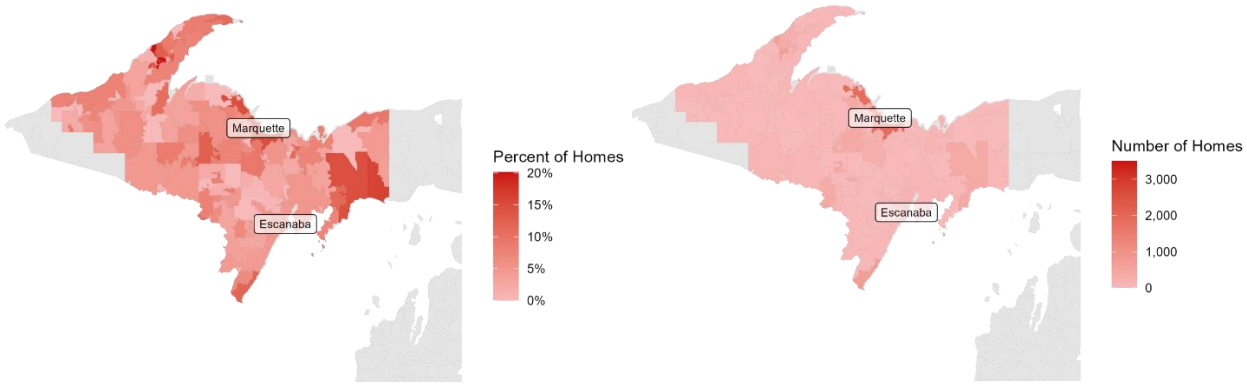

Figure 12. Prevalence (left) and number (right) of electric heated homes in UPPCO territory

Comparing Rates

Rates are a major driver of the value proposition of a heat pump compared to conventional heating and cooling equipment. In Table 8 we outline available residential electric rates for all MIHPC utilities. Barring installation of additional submetering infrastructure, I&M currently has the lowest available rate for residential customers using electricity as their primary source of heat. Overall, DTE has the lowest available volumetric rate for customers using electric heat; either through the interruptible cooling rate or geothermal time-of-day rate.

Table 8 MIHPC Uility Volumetric Electric Rates (Summer 2022)

Utility	Standard Residential Rate (winter)	Heating Service Rate	Cooling Interruptible Rate (winter)	Time of Use Rate (winter)
Consumers	$.172[21]	N/A	Credit[22]	Multiple (about same)
DTE	$.170	N/A	$.121[23]	$.130[24]
I&M	$.174	$.152[25]	N/A	$.150[26]
UPPCO	$.205	$.178[27]	N/A	N/A

[21] Standard rate is different in winter and summer.
[22] No changes to $/kWh rate but customer receives $32/year credit ($8/month from June-September)
[23] CoolCurrents interruptible cooling rate. Low end estimate of $700 meter install for customer to get on rate.
[24] Geothermal Time of Day Rate. Weighted average of on-peak and off-peak winter rate. Note that customer needs to pay for meter install at cost of at least ~$700
[25] Residence has permanently installed electric-heating equipment as primary source of space heating. All kWh during billing months of November-May billed at this rate.
[26] All winter hours included at this rate.
[27] For when major electric space heating facilities are permanently installed and are the primary source of space heating. Assumes anything over 500 kWh per month is for space heating and applies this rate above that threshold.

When assessing heat pumps eligible for EWR rebates, higher baseline electric rates present a better value proposition due to the decline in electric consumption. A lower heat pump rate such as the one available for DTE customers that adopt a GSHP further improves the value proposition. However, for the larger residential market in Michigan where space heating comes from delivered or regulated fuels, when considering a customer's overall heating bill, lower electric rates increase the economic value of heat pumps.

One challenge when thinking about the general market opportunity of heat pumps in Michigan is that Michigan tends to have higher electric volumetric rates than neighboring Midwest states. For example, the highest standard residential rate of any utility in the State of Wisconsin is under $.15/kWh.[28] ComEd, serving northern Illinois, has a standard rate that is under $.13/kWh. One Michigan region where dual fuel heat pumps have gained traction is in Great Lakes Energy territory where the standard residential electric rate is $.12/kWh and many customers currently rely on expensive propane.

Table 9 displays 2022 average Michigan natural gas and propane prices, and using the average rate of $.17/kWh, what the cost-equivalent coefficient of performance (COP) must be for operational cost parity. This data can be interpreted in a few ways. First, on a heating season basis, an all-electric heat pump would need to achieve the average COP listed to result in total energy bills remaining the same. From another perspective, in the case of dual fuel heat pumps, the outdoor air temperature where the heat pump COP drops to the level indicated would be the economic switchover temperature where it begins to make more sense to heat with the backup fuel at that temperature and lower. Based on the dual fuel heat pump field study completed in Michigan, heat pumps with natural gas backup would only make sense to operate to around 45-50°F for operational cost parity whereas heat pumps with propane backup would make sense to operate down to 5°F to 25°F depending on the heat pump model selected.

Table 9 2022 Average Michigan natual gas and propane prices

Fuel	Rate	Cost-equivalent COP[29]
Natural Gas	$10.78/MCF	4.3
Propane (winter average)	$2.37/gallon	1.7

As the MIHPC considers the future potential for heat pumps, rate design will be an important factor which will include not just the volumetric charges but fixed utility charges as well. As more customers opt for dual fuel heat pumps, delivered fuel and natural gas providers may be pushed to increase monthly fixed charges for those customers. On the other hand, electricity providers may decide to decrease fixed charges and as shown above, some MIHPC electric utilities already have lower volumetric charges for customers with electric space heating. Rates

[28] https://apps.psc.wi.gov/RATES/tariffs/default.aspx
[29] Assumes 90% AFUE furnace and $.17/kWh electric rate. Doesn't include electric fan operation from furnace which could add $150/year in operational costs.

emerged as an important topic that market actors need guidance on when presenting the best heating and cooling solution for their customers. We will discuss this further in contractor training content recommendations.

HEAT PUMP ENERGY WASTE REDUCTION (EWR) PROGRAMS

HEAT PUMP PROGRAM DESIGN AND PERFORMANCE

MIHPC utilities offer heat pump rebates through a variety of channels. As shown earlier, utilities have invested many resources to piloting different heat pump program designs. Heat pumps are a part of each collaborative utility's current EWR program, typically embedded within their larger HVAC program. MIHPC utility heat pump incentives are relatively limited since Michigan IOUs, based on current state conditions, are prohibited within EWR rules from encouraging or incentivizing fuel switching.

Notably UPPCO is the only collaborative utility that solely offers rebates for heat pumps in its standard rebate program and not rebates for furnaces or central AC. UPPCO is also the only utility to offer a bonus for cold-climate heat pumps. Currently, all utilities except UPPCO are offering heat pump water heater incentives through the midstream channel. In June 2022, I&M fully transitioned to midstream for all its heat pump measures.

As shown in Table 8 below, rebate levels for ASHPs are consistently below $1,000 with a minimum SEER of 15 or 16. Mini-split rebates are similar to ASHPs. The rebates for GSHPs vary widely across the utilities from as low as $200 up to $1,500.

Program designs have changed over the years for some utilities while other pieces have remained constant. For example:

- DTE has only rebated HPWH through its midstream program and had an incentive increase in May 2021.
- Consumers Energy and DTE started a midstream pilot with Lennox on August 1, 2022 providing an additional $25 bonus for each heat pump unit sold.
- I&M moved all HVAC incentives to the midstream format in June 2022.

Table 10 2022 MIHPC Utility Single-Family Market Rate Programs

Utility	ASHP	GSHP	Mini-Split	HPWH	Contractor Network
Consumers Energy	$150 SEER: 15.0	$200 EER 17.0 18.99	$250 SEER 18.0 – 20.99	Midstream $650 UEF > 2.0 Max 55 gallons	Yes
	$250 SEER16.0+	$300 EER 19.0+	$350 SEER 21.0+		
DTE	$150-$250 SEER 15-17	$800 EER: 17+	$1,000 SEER 18+ HSPF 9+	Midstream $650 Max 55 gallons UEF ≥ 2.0	Yes
	$750 SEER 18				
	$850 SEER 19+				
I&M	Midstream	Midstream $450 SEER 20+	Midstream	Midstream $350 UEF ≥ 2.0	No
	$250 SEER 16		$200 SEER 19 HSPF 9.5		
	$350 SEER 17		$350 SEER 21 HSPF 10		
	$550 SEER 18+		$550 SEER 23+ HSPF 10		
UPPCO	$300 per unit Min. SEER: 15	$1,500	$300 per unit Min. SEER: 15	$350 Rebate for UEF ≥ 3.0 ENERGY STAR	No
	$100 bonus for SEER over 21		$100 bonus for SEER over 21		
	$100 bonus for HSPF over 10		$100 bonus for HSPF over 10		
	$200 bonus for inclusion on the NEEP CCASHP list		$200 bonus for inclusion on the NEEP CCASHP list	$600 Rebate for UEF ≥ 3.5 ENERGY STAR	

Multi-Family Market Rate Programs – 2022

Most of the utilities provide the same incentive structure for multi-family buildings as single-family. The exception is Consumers Energy which provides the following ASHP incentive structure:

- 14.5 SEER, 8.7 HSPF - $15 per ton
- 16 SEER, 9.0 HSPF - $35 per ton
- 18 SEER, 9.7 HSPF - $65 per ton
- 21 SEER, 9,7 HSPF - $95 per ton

Consumers Energy and DTE consider multi-family as four or more units without separate entrances while I&M considers multi-family as two or more units.

Program Performance by Measure

To better understand the performance of current MIHPC utility heat pump programs, each were asked to provide rebate data by equipment type. Since each utility offers slightly different program designs, the data received may not be perfectly aligned with one another. Figure 13 below shows the number of ASHP rebates during the 2020-2021 period broken down by utility provider. Depending on the utility provider, the number of program participants for ASHPs has varied significantly in this period. For instance, in 2020, I&M provided more than double the number of ASHP incentives than UPPCO and DTE combined. However, DTE (139%) and UPPCO (35%) both saw an increase in their number of ASHP program participants in 2021 as compared to 2020 while the I&M program participation counts decreased by 12%. Consumers Energy experienced similar ASHP rebate quantities in 2020 and 2021.

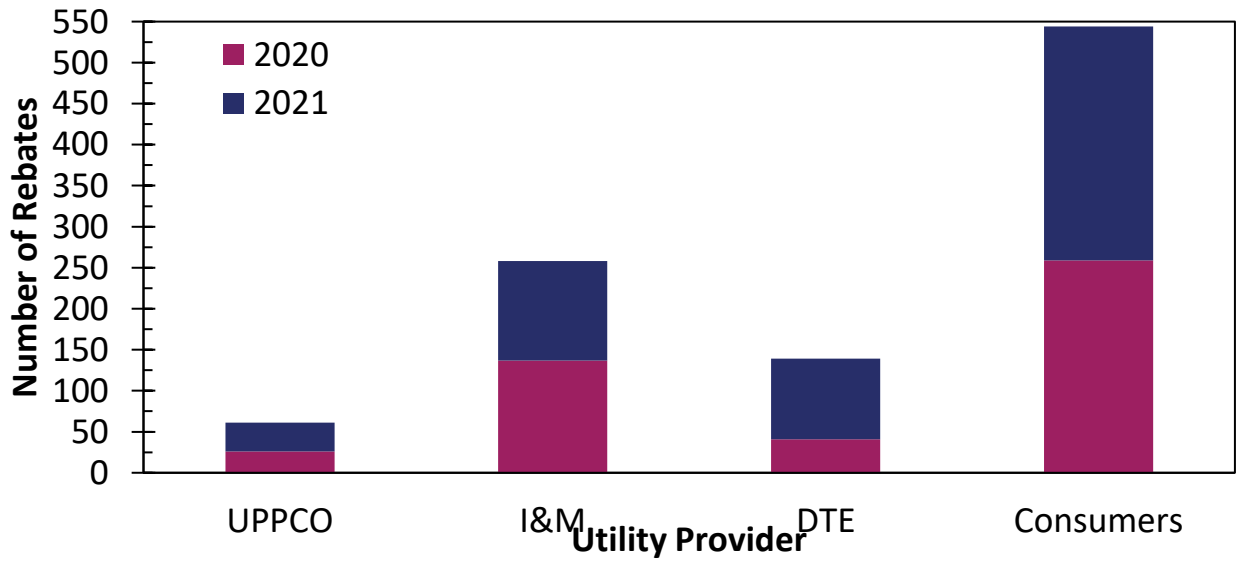

Figure 13. ASHP program participants by utility provider in 2020 and 2021

Figure 14 provides a glimpse into the historical trends of ASHP program participation in Michigan. Consumers Energy rebated the most amount of ASHPs in each of the four program years. DTE ASHP rebates grew the most on a percentage basis from 2020-2021.

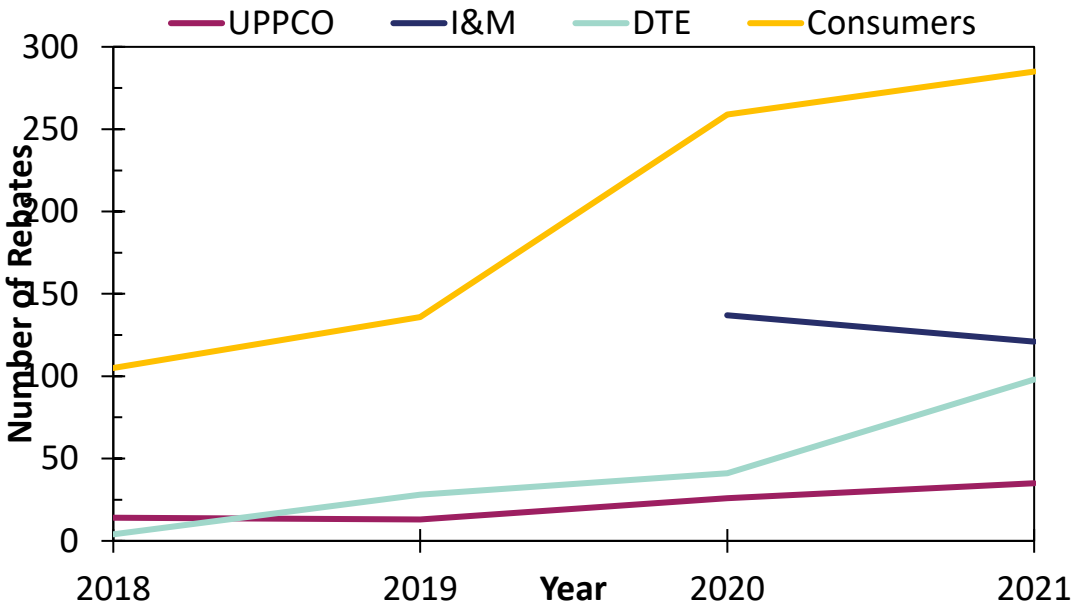

Figure 14. ASHP program participants by utility provider from 2018 to 2021

From 2018-2022, out of the total number of ASHP projects with a manufacturer identified, the following five manufacturers were the most commonly rebated in MIHPC member utility programs: Bryant/Carrier, Fujitsu, Mitsubishi Electric, Daikin, and Lennox. Please note that the data behind Table 1111 includes partial data for 2022 from select utility providers. 64 Mitsubishi Electric systems were installed in DTE's income-qualified heat pump pilot but are not included in this data.

Table 11. Top five ASHP manufacturers based on reported program participants for all utility providers from 2018 to 2022

Manufacturer	% of Total Identified Manufacturers
Bryant/Carrier	25%
Fujitsu	24%
Mitsubishi Electric	15%
Daikin	8%
Lennox	6%
Total	**78%**

For HPWHs, UPPCO and I&M provided over 30 rebates during the 2020 to 2021 time-period (Figure 15). On the other hand, DTE had only provided 5 HPWH rebates and Consumers Energy only provided 7 HPWH rebates during this timeframe.

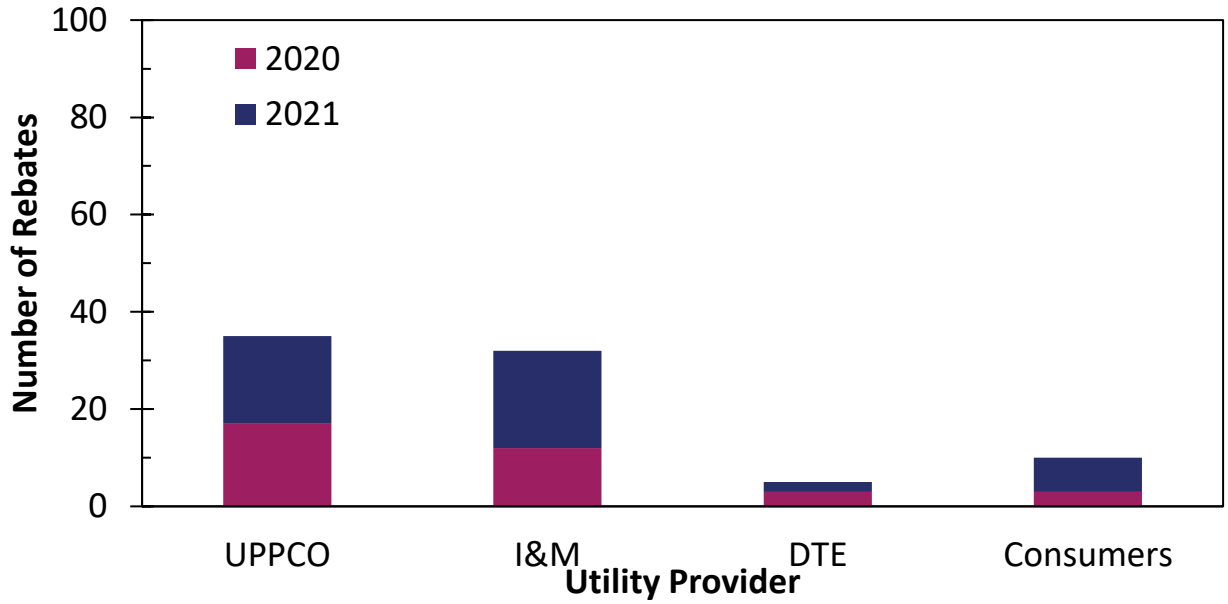

Figure 15. HPWH program participants by utility provider in 2020 and 2021

In contrast, DTE and Consumer Energy's program participation for the GSHP is significantly higher than UPPCO and I&M (Figure 16). During the 2020 to 2021 period, UPPCO had no GSHP program participants reported, and I&M only rebated seven customers in total during this time while DTE rebated 93 GSHPs and Consumers Energy rebated 111 GSHPs.

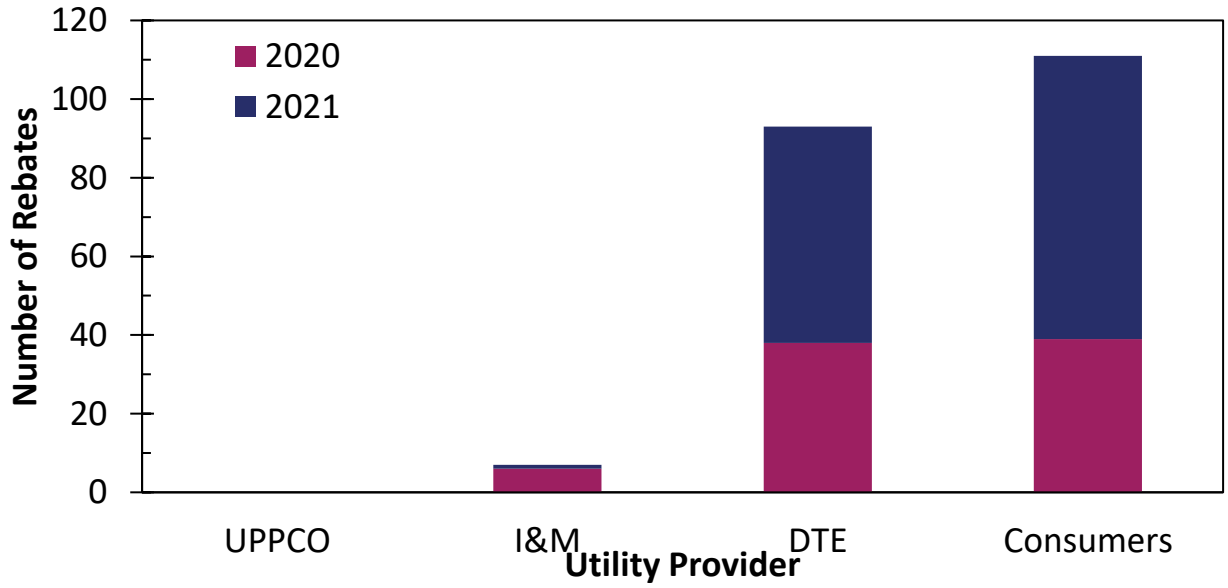

Figure 16. GSHP program participants by utility provider in 2020 and 2021

Table 12 below lists the top five identifiable manufacturers of GSHPs that were rebated by MIHPC utilities between 2018-2022. Collectively, Water Furnace, Bosch, Enertech, Bard, and Well-Connect accounted for 88% of GSHP rebates reported by manufacturer. Similar to the data on ASHP rebates, Table 1212 data includes partial reporting for the 2022 calendar year.

Table 12. Top 5 GSHP manufacturers based on program participants for all utility providers from 2018 to 2022

Manufacturer	% of Total Identified Manufacturers
Water Furnace	40%
Bosch	17%
Enertech	11%
Bard	11%
Well-Connect	9%
Total	**88%**

DTE home comfort program

Outside of the EWR context, DTE has recognized a value proposition to incentivize heat pumps as a load growth measure from a shareholder perspective. Starting in June of 2022 DTE has offered $1,500 to contractors for every heat pump installed with a minimum $500 pass-through to the customer. The contractor-focused approach is intended to help contractors new to the technology to help get them started and offset some of their costs to entice them to enter the market of heat pump installations. As of October, approximately 25 heat pumps were installed, and all were dual-fuel systems. DTE additionally offers a general concierge service for residential customers considering a heat pump for their home. This service has helped drive participation in DTE's incentive offering with approximately 25% of heat pump conversions coming through the service.

MIHPC Utility Program Summary

Heat pump program performance has varied widely among the different technologies and utilities. The data shows the difference that a robust rebate can make in program performance as shown by DTE's success with GSHPs compared to the other utilities. While UPPCO has the highest rebate for a GSHP, it has only paid out one rebate in four years. This is likely due to limited contractors and the geological conditions of the western UP that increase the upfront cost of the ground loop coupled with high electric rates. Even with high rebate levels, utilities will struggle with participation if there aren't enough contractors in their service territory and certainly UPPCO's rural service territory can hamper many contractors from serving the area. Fuel switching restrictions have likely hindered participation in the programs even though heat pumps have been gaining traction in the state as shown from the HARDI data. Another pain point has been the limited channels that rebates are offered for some measures. Rebates that

are offered on equipment through retail, midstream and downstream can help increase participation as customers are able to select the channel that works best for them. This is especially true of a measure like HPWHs that could be self-installed or installed by a contractor.

Consistency is also key when it comes to program design and rebates. Since distributors tend to order equipment many months in advance of when it's going to be installed, they need to know what the rebates and eligibility requirements will be well ahead of time. It does appear that the utilities have been consistent with their market rate programs while some of the pilot efforts have confused contractors due to their limited time availability and inconsistent designs. While some design changes were welcome such as allowing rebates for ASHP for an AC replacement, quick removal in the same year the rebate was released led to customer and contractor confusion. Another reason for consistency is to make it easier for contractors when they are providing estimates to customers. If they are providing an estimate on a project that may not happen for a few months, they will want to ensure the rebates and equipment eligibility will be the same when the time comes to install the equipment in the home.

COMPARISON TO OTHER HIGH-PERFORMANCE AND MIDWEST HEAT PUMP PROGRAMS

The following section describes the regulatory and policy environment, highlights various approaches to heat pump program design, and shares available program results for seven heat pump programs across the Midwest and Northeast.

Michigan Electric Cooperative Programs

The Michigan Electric Cooperative Association (MECA) previously administrated an EWR compliant rebate program from 2009 to 2021. Thirteen cooperative and municipal electric utilities subscribed to the Energy Optimization collaborative. Over the 12-year period significant investments led to robust educational materials for cooperative members and contractors to understand the alternative heating solutions for electric resistance, delivered fuel, and wood heat. Educational materials included instant discounts coupons for heat pump water heaters, introductory heat pump classes for Trade Allies, six case studies explaining dual fuel central ASHP and mini splits, along with a website and printed air source heat pump explainer. Trade allies that were also cooperative members were able to access new heat pump technology at nearly no cost with the help of the rebates. After installing and using the products in their own home they became advocates of the technology and started to proactively offer heat pumps to their customers instead of just responding to customer inquiries.

The legislative requirement for cooperatives and municipalities to provide EWR programs sunset at the end of 2021. Utilities including Lansing Board of Water and Light, Holland Board of Power & Water, Cherryland Electric and several utilities in the Efficiency United and Energy Smart collaboratives opted to continue offering rebates to their customers in 2022. Additionally, the third largest electric utility in Michigan, Great Lakes Energy, along with the smaller electric cooperatives Cloverland Electric, Homeworks Tri-County Electric, and Presque Isle Electric and

Gas, all opted to continue offering incentives on a large variety of measures including heat pumps and began allowing incentives for fuel switching.

While new generation cooperative programs are independent, to meet market needs, most electric utilities have very similar eligibility requirements and incentives for heat pumps. The focus is on heating efficiency. HSPF is the main efficiency requirement incentives and requirements are found in the appendix. The most notable change is the inclusion of a Tier 2 incentive for Cloverland Electric. With increased interest in electrification and rising propane prices all four cooperatives' utilities are considering inclusion of the NEEP tier in 2023.

Focus on Energy

Created in 2001, Focus on Energy is Wisconsin utilities' statewide program for energy efficiency and renewable energy. Like EWR, Focus on Energy is a resource acquisition program at its core. The program currently offers incentives for ASHPs, GSHP, and HPWHs. Fuel-switching policy language changed in early 2021 and savings from fuel switching are currently allowable for regulated fuels but not for delivered fuels. Therefore, 2022 incentive levels tend to be less for heat pump installations replacing or displacing propane compared to natural gas.

In 2022, ASHP incentives were split in their incentive delivery. Unitary ASHPs, including dual fuel, were rebated downstream, and ductless mini-splits were rebated midstream. In 2023, ductless mini-splits will be rebated downstream again as the program seeks to align all residential HVAC measures and work towards simplifying the heat pump measure for customers and trade allies. Central AC rebates are also no longer available as they were determined to not be a cost-effective measure.

In 2022, the dual fuel heat pump rebate is $1,000 when replacing natural gas or electricity and there was a $500 bonus for rebates claimed between July 2022-December 2022 resulting in a total available rebate of $1,500 per system. The dual fuel heat pump rebate is $300 when replacing propane and mini-split rebates are $300 and must replace electric or natural gas heating. GSHP rebates are $1,000 when replacing natural gas and are otherwise $750. Overall, Focus on Energy has experienced significant growth in the total number of heat pump rebates due to the availability of the dual fuel heat pump beginning in 2021.

For water heating, Focus on Energy offers rebates starting at $300 for HPWHs through the midstream channel. Until recently, HPWH rebates were not listed on the website, so it was difficult for a consumer to know about them. Participation among distributors has been low and many more HPWHs are rebated through the new construction program which is likely due to strong relationships with builders.

Focus on Energy relies heavily on its trade ally network to promote programs. Trade allies may apply to be listed in a "find a trade ally" tool and self-report their trade. In addition, co-branding opportunities are available and trade allies may receive 50% and up to $500 reimbursement per year to promote their partnership with Focus on Energy.

Focus on Energy is currently investigating the role that air-water heat pumps and gas-fired heat pumps may play in future programs. Focus on Energy is also investing in the development of a customer buying and operational guide for air source heat pumps and considering how to

further engage with the trade ally network in education and training. Finally, Focus on Energy is actively engaged in the Wisconsin heat pump coalition, which is made up largely of manufacturers and distributors, to pay close attention to market actor insights and recommendations.

ComEd

Prior to 2019, ASHPs were hardly rebated through ComEd's residential HVAC program. In 2020, ComEd increasingly pushed ASHP technology and by the end of 2020 all ASHP measures were shifted to midstream delivery. In September 2021, the Climate and Equitable Jobs Act (CEJA) passed in Illinois which makes it possible for ComEd to offer and promote measures that electrify space and water heating if they reduce overall energy consumption. Consequently, ComEd has invested more heavily in heat pump research, market development, consumer empowerment, and program design and incentives.

Due to the delivery of ASHP incentives being midstream and no pass-through amount required, incentive amounts are not published for customers. In the latter part of 2022, ComEd introduced bonuses that made it possible for the highest-efficient ASHP to receive a total $2,000 rebate.

Given ASHPs currently fit into a midstream delivery model, ComEd's program delivery team focuses on distributor outreach. ComEd is also undertaking a two-year ASHP contractor training and education pilot. Currently, training is not required but ComEd is actively considering the value proposition to participating trade allies and future participating trade ally program requirements. ComEd has a learning management system with modules and resources for HVAC contractors. One such resource is cost of heat guides. These guides provide information for contractors to use while sitting with the customer to show them the potential impacts to their energy bill depending on their current heat source: propane, natural gas or electric heat. The team is also focused on "idea exchanges/training-the-trainer" to reach influential individuals at large HVAC contractors and distributors. Finally, the team is standing up a product ownership program where HVAC contractors and technicians newer to, or leery of, heat pumps can gain valuable hands-on training and firsthand experience with the technology as they install it in their own homes. ComEd has also recognized the need to invest in further consumer education and is developing a website that meets the needs of this audience as well.

ComEd's GSHP incentives are currently offered downstream and must be installed by certified installers. In 2022, ComEd does not have a broad incentive offering for HPWHS but has begun to focus on pilots, market development and the integration of HPWHs into future program years.

Minnesota ASHP Collaborative

In Minnesota, new legislation has opened the door for market transformation of heat pump technology in the state. The Energy Conservation and Optimization Act (ECO), Natural Gas Innovation Act (NGIA), and MN Efficient Technology Accelerator Program (ETA) collectively make it possible for efficient fuel switching in utility programs and a market transformation framework to advance heat pump technology. Notably, natural gas utilities in the state may now claim savings from heat pumps replacing fossil-fuel furnaces towards their energy efficiency goals.

Center for Energy and the Environment (CEE) has spent the past three years implementing the Minnesota ASHP Collaborative on behalf of five utility funders. As part of the ETA program, dual fuel ASHPs as AC replacements are prioritized as part of the starter 2023 portfolio of technologies. This Collaborative will expand statewide to transition Minnesota's 1.2 million homes with ducted central AC and natural gas furnaces to ASHPs.

The MN ASHP Collaborative has implemented a market intervention approach designed to accelerate ASHP installations while also promoting quality installations by working upstream in the market to remove barriers to technology adoption. This approach is complimentary to the utility rebate programs in that it's priming the market and the utility rebates are a tool to increase consumer awareness and reduce first cost. The MN ASHP Collaborative focused on manufacturer and distributor engagement to optimize heat pump stocking and pricing as well as to collaborate on contractor training. The Collaborative developed a contractor training curriculum which can be viewed on demand or in live format and developed a "Preferred Contractor Network" to connect early adopter customers with early adopter contractors. The program also has been a resource for installation best practices by gaining in-depth understanding of application types based on field research and disseminating these best practices through training but also site inspections and direct contractor engagement. The Collaborative also served to coordinate and align utility program efforts and customer support. Both customer and contractor resources live on the website and include case studies and operational cost guides based on different utility prices. The MN ASHP Collaborative currently does not deliver incentives directly but instead coordinates and aligns utility rebate activity.

As the MN ASHP Collaborative completes its third year, the CEE team has emphasized how it has taken time to strengthen distributor and contractor relationships and that a focus on early adopters has helped compel more distributors and contractors to sell and properly install heat pumps. Key lessons learned to date are that in homes that are electrically heated or heated with propane, the value proposition is strong and heat pump sales are increasing. Contractor engagement as well as distributor engagement is on the rise. Some challenges remain however in markets with predominantly natural gas heated homes because the economic value proposition is not as strong. Additionally, supply chain constraints and inflation have increased wait times and first cost which is an ongoing challenge to customer adoption. But overall, with the Inflation Reduction Act, utility rebate programs and increased manufacturer focus on promoting heat pump technology, sales are increasing, and customer interest is on the rise.

Efficiency Vermont

Efficiency Vermont is a statewide energy efficiency program created in 1999 by the Vermont Legislature and the Vermont Public Utility Commission. Efficiency Vermont was an early leader on energy efficiency, launching services to help reduce energy costs and protect the environment in 2000. Efficiency Vermont is uniquely established as a regulated energy efficiency utility with an initial focus on electric energy efficiency savings. Before its creation electric energy efficiency programs were delivered by individual electric utilities.

Vermont was the first state to bid energy efficiency into a regional electric grid, demonstrating that energy efficiency is a reliable, cost-effective resource in meeting energy needs. In 2008 Efficiency Vermont received authorization to offer thermal efficiency services statewide to reduce fossil fuel usage, improve occupant comfort in buildings, and save on heating costs. Efficiency Vermont partners with Vermont Gas Systems, the Vermont Fuel Dealers Association, and Vermont contractors to deliver thermal efficiency services.

Fuel switching incentives in Vermont are typically offered by electric distribution utilities and not the statewide energy efficiency program pursuant to restrictions on Efficiency Vermont's ability to use system benefit charges to fund fuel switching incentives. The 2015 Renewable Energy Standard (Act 56) addresses building electrification and drives individual electric distribution utility's fuel switching efforts. Act 56 has three tiers. Tiers I and II address renewable energy requirements and Tier III requires individual electric distribution utilities to reduce customer fossil fuel use through electrification, efficiency, fuel switching, or storage. The reduction requirement is 2% of annual sales starting in 2017 and increases by 0.67% annually to reach 12% in 2032. Efficiency Vermont claims electric savings from heat pump installations; however, distribution utilities claim the fossil fuel savings under Tier III of Act 56.

Public Service Board Docket 8550 additionally gives rules and eligibility criteria for allowable programs under Tier III including:

- A net reduction in fossil fuel and GHG emissions
- Lowest present value life-cycle cost
- Utility cost less than applicable Renewable Portfolio Standard (RPS) alternative compliance payment

Vermont has progressively explored ways to expand electrification investment and specifically heat pumps, and in 2020 the Energy Efficiency Modernization Act (S. 337) was enacted, which allows Efficiency Vermont to allocate up to $2 million of existing funding for three-year pilots that reduce greenhouse gas emissions in thermal and transportation sectors.

Efficiency Vermont offers downstream incentives for ducted air source heat pumps, heat pump water heaters, ground source heat pumps, and water source heat pumps. The program also offers midstream incentives through distributors for ductless air source heat pumps and heat pump water heaters. Financing is also available as a complement to cash incentives to help customers overcome first-cost barriers.

Efficiency Vermont relies on NEEP's qualified products list for eligible heat pump measures, and has designed programs with a strong focus on education and outreach regarding heat pump technology. For example, a wide range of events are held to enhance outreach with schools, business associations, nonprofits, community groups, and others to facilitate greater understanding of energy efficiency and electrification. Over the course of several years the program assembled and stood up a supply chain team consisting of account managers who support distributors and contractors as a single point of contact within the program. This structure facilitates market discussion about product types and benefits of adoption. The program also works closely with customers, particularly related to ductless air source heat pumps, which as noted above, is a midstream offering well suited to the statewide nature of the programs. Perhaps owing in part to strong underlying policy that supports decarbonization

through electrification, and a uniquely environmentally-focused culture among Vermonters, customers participating in Efficiency Vermont heat pump programs are not asked to provide information about their incumbent fuel, and the technical resource manual used to claim savings blends / does not distinguish fuel types. Although there are similarities between Michigan, Vermont, and Maine in terms of cold climate and relative presence of delivered fuels, Efficiency Vermont's simplified approach to collecting fuel information and claiming savings may not be replicable in other states for various regulatory and administrative reasons.

Efficiency Vermont is exploring multiple program innovations. The program introduced an integrated controls offering for heat pump technologies in November 2021, however the program is not yet realizing uptake. The offering is available for new construction and not existing buildings. The program is also incorporating refrigerant management aspects into heat pump programs and will be socializing refrigerant management best practices with its trade ally network in the near term.

Whereas Efficiency Vermont has long demonstrated decarbonization leadership and modeled program innovations, state and regional policy, and cultural, structural, and administrative conditions play an enabling role that may not be replicable in the short term in Michigan.

Efficiency Maine

The Efficiency Maine Trust (Efficiency Maine) is the statewide program to improve the efficiency of natural gas and electric energy use and reduce greenhouse gases in Maine. Efficiency Maine serves all sectors with a suite of nationally-recognized programs, which include consumer information, discounts, rebates, loans and investments for high-efficiency, clean energy equipment and strategies to manage energy demand. Efficiency Maine is a quasi-state agency governed by a Board of Trustees with oversight from the Maine Public Utilities Commission. The program was created in 2009 by the Efficiency Maine Trust Act: Maine Statute Title 35-A, Chapter 97. Maine law requires Efficiency Maine to secure all cost-electric efficiency from utilities paid from rates. Although utility regulation does not permit fuel switching from rate payer funds, in 2019 Public Law Ch. 306, LD 1766 established the goal of installing 100,000 high-efficiency heat pumps by 2025 and required that RGGI and Forward Capacity Market (New England ISO) funds be directed to complementary electrification efforts. These revenues are used to support fuel switching, and the state has counted fuel-switching savings from unregulated fuels since 2020.

Efficiency Maine has framed scalable, market-based electrification as a goal requiring superior customer satisfaction, making the transformation an attractive business opportunity for businesses and installers, and supportive policy. To fulfill a commitment to superior customer satisfaction, the Efficiency Maine website features heat pump user tips, frequently asked questions, and case studies. The website uses various media (e.g. including video and downloadable materials) and features a calculator that helps consumers compare home heating costs based on fuel type and equipment used. The website also hosts a contractor /vendor look-up tool for customers.

For quality assurance, the program requires vendor/contractor registration. This includes basic requirements, such as executing a code of conduct agreement and insurance. To be registered, a heat pump contractor must have:

- One employee with EPA Section 608, Type II or Universal Refrigerant Handling Certification,
- One employee must have ductless heat pump installation training provided by a manufacturer of ENERGY STAR heat pumps or an Efficiency Maine Registered Trainer, and
- One member of each crew must have an Efficiency Maine Annual Heat Pump Basics training certificate.

The program offers downstream incentives for air source heat pumps, ground source heat pumps, and heat pump water heaters. In addition to the downstream intervention for heat pump water heaters there is a distributor channel and unique offerings by retailer. The program does not have weatherization or energy audit requirements with the rationale that not having these requirements lowers the hassle barrier for customers. Financing is also available for all heat pump technologies through the program.

Efficiency Maine has established a robust heat pump trade ally approach. Trade allies have access to rebates, financing, heat pump training scholarships, and by completing requirements are listed on the programs registered vendor list for customers to find. Additionally, trade allies can subscribe to newsletters where program updates and quality assurance guidance are provided. The program also makes sales tools available, including dozens of marketing materials like brochures and case studies, and offers co-op marketing where up to 50% of preapproved materials are reimbursed up to $5,000.

Through policy and program interventions, Efficiency Maine saw air source heat pumps installed in 7% of Maine homes in 2019 and expects to see air source heat pumps installed in 22% of homes by 2024. The program expects to have 55,000 heat pump water heaters installed, cumulatively, by the end of 2022, representing 10% of occupied dwellings. Displacement of tankless coils is noteworthy. Overall, customer satisfaction with heat pump programs is very high, with surveys showing about 90% of customers are very satisfied with contractors and 90% saying they would recommend the program to a friend.

Beyond consumer satisfaction, Efficiency Maine is finding emission reductions are significant and the economics are strong when replacing oil and propane equipment with the highest HSPF models. Economics are also favorable when replacing electric resistance and tankless coil domestic water heating. It is also possible the program interventions may suppress electric rates in declining rural utilities. Competition in the market is present with a range of products, vendors, and installers, with a positive impact on prices for consumers. The training ecosystem among trade allies is strong and contribute to a good customer experience. Enhanced incentives help realize equity goals, and the program believes air source heat pumps and heat pump water heaters fit well in direct install programs.

Efficiency Maine finds that information barriers still remain concerning misunderstanding related to untrained supply chain actors, fuel dealers, and how to optimize air source heat pump

performance when retrofitting as a partial heating solution in existing homes. While the policy environment has enabled program success, distorted price signals remain across fuels.

Mass Save

Mass Save is a statewide administered energy efficiency program that launched over 30 years ago and is managed and delivered by gas and electric providers from across the state. In 2018, the Act to Advance Clean Energy introduced a new focus of electric energy efficiency on measures that reduce greenhouse gas emissions. In 2021, S.9. (An Act Creating a Next-Generation Roadmap for Massachusetts Climate Policy) introduced emissions reduction mandates for the next three decades as well as technology adoption benchmarks which included heat pumps.[30] Mass Save can now claim savings from fuel switching from natural gas beginning in the 2022-2024 program portfolio. Mass Save indicated that 2022 is a stage-setting year as it seeks to grow and expand its program to achieve deeper savings from heat pump technologies.

Mass Save has offered ASHP, GSHP, and air-water heat pump rebates downstream historically. ASHPs are rebated at different levels for whole-home or partial displacement. Whole-home heat pumps must meet weatherization requirements. In 2022, a midstream rebate was developed for ASHPs that does not require pass-through to the customer. The rebate is intended for the distributors to cover administrative fees to participate in the program with a goal of ensuring they stock and sell cold-climate heat pumps to contractors. Only electric cooling savings are claimed through this midstream model. Mass Save has incorporated income eligible design features in the program which includes increased incentives for heat pumps and a requirement for weatherization due to it being zero-cost. Heat pump water heaters are offered midstream through both distributor and retail channels.

Mass Save describes their heat pump program interventions falling within the categories of customer awareness and acceptance, contractor enablement, and manufacturer/distributor engagement. Mass Save emphasizes how the supply chain is integral to the success of the program and that these market actors appreciate the ability to provide input during the program planning process.

Mass Save has a relatively newly formed residential heat pump installer network that was announced in Q4 2021. As of October 2022, over 600 companies have enrolled in the network and 85% of ASHP installs rebated by the program in 2022 were completed by participating contractors. Mass Save indicated that it is too early to tell if the installation quality has improved but has found a lot of value in having a relevant channel to communicate with the network. Mass Save intends to begin closing rebates to contractors who hold their designation but still seeks to examine data before making a final decision. Other than this potential requirement for customers to use a designated heat pump installer, Mass Save offers many benefits to trade allies in the network. We outline those below when summarizing other utility and statewide heat pump designations. In general, Mass Save described how they see contractors as the face of their program since they're in customer homes and want to make sure they feel supported, and

[30] https://www.aceee.org/sites/default/files/pdfs/state_fuel-switching_policies_and_rules_7-21-22.pdf

they have the tools necessary to communicate effectively to customers. Trade allies have historically not been allowed to use the Mass Save logo, but Mass Save is working on creating a logo for in-network heat pump installers to use in marketing materials.

Mass Save surveys have revealed that over 50% of residential customers in the state are not too familiar/not at all familiar with heat pumps.[31] They also discovered that even if a customer does know what a heat pump is, the benefits are infrequently understood. To address this customer knowledge gap, Mass Save deploys several tactics. In addition to standard statewide marketing and brand awareness and relying on the program administrators (the utilities) for targeting marketing, Mass Save highlighted two new customer education interventions they developed. First, they now offer virtual heating and cooling replacement consultations with a technical specialist. This program has seen a lot of volume so far in 2022 but at this point Mass Save is uncertain how many installations could be attributed to the program. The consultation is not specific to just heat pumps. Second, Mass Save offers a heating comparison calculator that is not precise but gives customers a rough idea of heating fuel costs, energy, and carbon impacts when installing a heat pump. They are training contractors on using this calculator with their customers.

These seven program summaries illustrate that the policy environment differ significantly between jurisdictions. Where decarbonization through electrification is policy enabled, e.g. with specific heat pump installation targets and fuel switching allowances that permit switches from natural gas and delivered fuels to electrification, heat pump programs have greater opportunity to attract market interest and promote and incentivize the technologies. Heat pump program design, particularly in utility environments, can borrow from long standing energy efficiency program design best practices, which includes options for experimentation and evolution as program offerings mature. Strong relationships with trade allies, emphasis on education and awareness, and meaningful rebate levels are throughlines in all program success. Emergent design elements, such as integrated controls, may more fully realize heat pump and electrification goals, though results are to be determined.

STAKEHOLDER NEEDS ASSESSMENT

To elevate the voice of the market, the MIHPC interviewed 13 manufacturers, eight distributors/retailers, and 19 contractors from across the state for a variety of heat pump technologies available in Michigan. Two community colleges and one trade school were also interviewed to better understand workforce development gaps and opportunities. Those insights are incorporated into our recommendations on workforce development market interventions. In Appendix C we include summary tables of all interview respondents. The announcement of federal rebates and tax credits has the industry both eager and anxious for final determination of minimum efficiency requirements. The stakeholder interviews helped establish a foundation of interested market actors the collaborative will need as partners to accelerate market development and proper installation of heat pumps.

[31] https://ma-eeac.org/wp-content/uploads/EEAC_2022-03-16-Heat-Pump-Market-Strategy-Revised.pdf

The installing contractors interviewed are a mix of enrolled trade allies and non-participants in MIHPC utility residential programs. Common themes emerged regarding training needs, barriers, and opportunities. Below are some high-level insights from contractors related to their experience with all types of heat pumps for space and water heating.

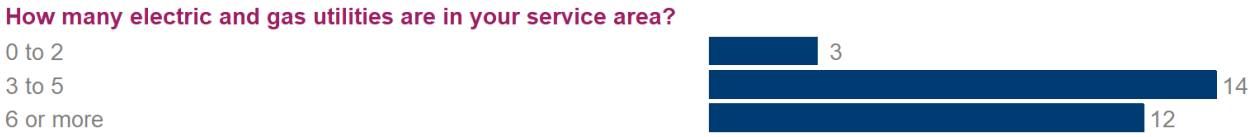

Figure 17 All contractors named the electric and gas utilities in their service area including municipal and cooperative electric utilities.

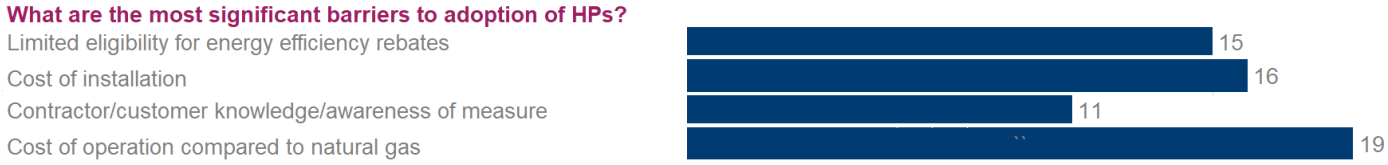

Figure 18 Contractor provided barriers, the total number is greater than the number of contractors interviewed as each listed multiple barriers.

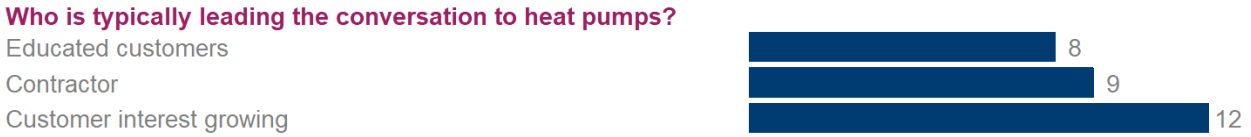

Figure 19 If contractor responded that both educated customers and themselves were leading the conversation to heat pumps, we identified that as “customer interest growing”.

Figure 20 Contractors provided multiple motivators, so the total number is greater than the number of contractors interviewed.

Interviewees indicated they would appreciate continuity among all utilities on the minimum efficiency requirements and rebates. Emphasis was placed on the need for more education about the variety of utility rebate methods. At this time several contractors and distributors indicated significant frustration with mid-stream rebate programs for residential equipment. Factors contributing to this include lack of transparency in the status of rebate reimbursement to contractors, added paperwork and accounting requirements at the distributor level, and in some cases significant reduction in rebate amounts. Unsurprisingly, contractors indicated they see EWR incentive eligibility and frequent program changes as major barriers to program participation and growing their heat pump sales. Contractors would prefer heat pump incentives to apply to anyone that chooses a high efficiency heat pump along with a transparent rebate process that can be accessed at the contractor or homeowner level. Since most contractors serve multiple utilities, some went as far to suggest the MIHPC might include all electric utilities and promote consistent and inclusive rebates for customers across the state.

Customer demand is increasing for heat pumps which along with inflation is increasing installation cost and affecting equipment availability. In addition to increased customer demand, equipment avaliability is further impacted as production capacity is still in recovery from COVID-19 restrictions and manufacturers are preparing models to meet 2023 efficiency rating changes. Greater incentives and expanding the eligibility for rebates to first time heat pump customers, would give contractors more reason to invest their time in attending trainings offered by their equipment manufacturers, distributors and the collaborative. However, in areas where natural gas is available, heat pumps are considered a luxury item outside of mini-splits, and few contractors offer the product with confidence due to fear of increasing operation costand limited experience with the technology.

Below we summarize market actor insights specific to each heat pump technology.

Air Source Heat Pumps

The air-conditioning and ASHP industry are undergoing substantial changes due to the expansion of inverter-driven equipment and its applications, regulatory updates, new energy efficiency qualifications, and federal incentives. The supply chain has communicated that energy efficient inverter driven heat pumps are gaining traction in Michigan and more homeowners are embracing zoned comfort solutions in lieu of, or in conjunction with, traditional furnaces and boilers. Distributors and contractors are aware of performance limitations of the older generation of single and two-stage unitary ASHPs, but unaware of proper application and design that address these limitations in geographies where heat pumps have not traditionally been utilized.. Furthermore, not all distributors and contractors revealed they value the benefits of more expensive inverter-driven equipment. Many distributors and contractors see ASHPs as a poor choice for their customers when coupling these perceptions with Michigan's relatively high electric rates, and currenly low natural gas rates. Most market actors interviewed were unfamiliar with special electric rates offered by DTE and UPPCO that substantially reduce winter time heating costs.

The EPA intends to phase down the production of HFCs by as much as 85% by 2036. The supply chain indicated concern that there will be limited availability of R-410a in the long run, but manufacturers and refrigerant reclaimers are actively addressing these phase-outs. The supply chain also indicated a potential issue in 2023 if refillable refrigerant cylinders are banned and a new production line of tanks is needed. Also, in 2023, new ASHP energy efficiency ratings will be enacted for the first time since 2008. SEER2 and HSPF2 ratings are derived from the new M1 rating procedure which more accurately simulates the static pressure conditions of existing distribution systems in homes. Consequently, SEER2 and HSPF2 ratings will be lower than their SEER and HSPF counterparts. 2023 will be a transition year. Until the equipment produced is all under the same rating, some equipment will be listed under SEER/HSPF and other equipment will be listed under SEER2/HSPF2. The MEMD has a conversion chart for SEER2 to SEER and 15 SEER ASHP are still eligibile for savings in the 2023 program year.

These changes paired with increased consumer demand are leading to difficulty in sourcing and identifying products. As indicated in contractor interviews product availability varies greatly by manufacturer and over time. A couple contractors indicated that they are currently sourcing

critical components for a single heat pump system across multiple distributors. This is a significant challenge for a mid-stream program as one distributor cannot verify the system rated energy effiecny or eligibility as they did not sell all pieces of equipment listed on the AHRI certificate.

Market actors acknowledge that greater contractor and customer education and awareness efforts are needed on the value propositions, operation costs, and setup for heat pumps. Distributors and manufacturers value and want the opportunity to provide more feedback in utility program designs and any early insights into IRA programs. Distributor stock liability is another barrier which may prevent some distributors from securing unitary heat pumps to offer in 2023. Certain decision makers at a distributor may not see the value proposition to take on the stock liability and increased financial risk. Many distributors are waiting to place stocking orders for 2023 until tax credit eligibility information is available as they believe this will be a big sales driver. Finally, distributors are acutely aware that midstream incentives pose a financial risk to them. For example, when high-cost product does not sell quickly, it takes up valuable space and cuts into overhead costs. Also, distributor fear being penalized and denied incentive reimbursement due to fraudulent behavior at the contractor or customer level which is out of their control.

Both ASHP manufacturers and distributors indicate they offer a variety of ASHP trainings to contractors and are supportive of MIHPC planned efforts. One key incentive they leverage to encourage contractor training is that manufacturer-trained contractors typically receive a longer equipment warranty. The number of units installed was recommended by one manufacturer as a possible requirement for MIHPC heat pump installer designation. Another manufacturer encouraged the MIHPC utilities to tie rebates to the contractor heat pump designation since that could drive leads and strengthen the value proposition for contractor participation. Consumer education and awareness building around the designation and how it works was also stressed as an important incentive to drive contractor designation network participation.

While the market is supportive of MIHPC's plan for online module training content, they expressed value in in-person training. Manufacturers and distributors emphasized how most existing contractors do better with in-person training and suggested the MIHPC partners with distributors to utilize their training facilities and training event recruitment. Finally, manufacturer representatives emphasized how open they are to collaboration. They typically see themselves as technology ambassadors and are in the business of changing the overall market to heat pumps and not just focused on product-specific sales and product-specific training.

In 2023, many contractors are planning for increasing heat pumps sales. One large southwest Michigan contractor remarked that heat pumps may replace all their central AC sales as customers are starting to inquire about IRA incentives and tax credits. Similarly, a distributor serving the west and central lower peninsula report a heavy shift towards inverter heat pump sales over traditional central AC.

ASHPs are in demand in other parts of the country as well, which increases cost and lead time. To the extent possible, distributors would like guidance from utilities on their goals for the number of heat pump rebates and income qualified installations well in advance of starting up a

program or pilot. Product is now being ordered upto 18 months in advance from when equipment is expected to be needed which means equipment is ordered and in stock before utility programs are designed and communicated. As one example, if a utility program seeks to qualify equipment based on a cold-climate equipment rating such as NEEP or ENERGY STAR, early conversations with distributors who would supply those products is important.

Heat Pump Water Heaters

The supply chain emphasized that HPWHs are an attractive product that has high potential for customer satisfaction and energy savings in Michigan. Below is a table describing the three primary manufacturers of HPWHs, their brands, and sales channels. Notably, retail channels are sometimes drawn from to enable residential customer DIY sales. Michigan-based Bradford White focuses only on a distributor sales channel to contractors.

Table 13 The three primary manufacturers of HPWHs, their brands, and sales channels

Manufacturer	Brand sold	Retail Sales	Distributor Sales
Rheem	Rheem, Ruud, Richmond	X	X
AO Smith	American, AO Smith, Lochinvar, Reliance, State	X	X
Bradford White	Bradford White		X

HPWH market actors communicated that the biggest opportunity to increase adoption of HPWHs is improving program design. Manufacturers have emphasized that incentives around $700 delivered through a midstream and retail program will increase adoption of HPWHs in Michigan. They cited programs by the Michigan electric cooperatives as success stories in building momentum for HPWHs as they exceeded or met manufacturer recommended incentive amounts, provided an easy application process, and marketed the product direct to contractors and end users.

All market actors reinforced that replacement of electric resistance water heaters (ERWHs) offer the best value proposition for customers based on operating cost savings. With relatively low adoption of HPWHs across the state, they see programs benefiting from an increased emphasis on ERWH replacements in customer marketing and outreach, and contractor trainings.

Distributors and manufacturers stressed the importance of driving increased consumer demand for HPWHs. Manufacturers cited tankless water heaters as an example where consumer demand shifting a market. Initially, plumbers were not interested in installing tankless water heaters, but a marketing campaign generated buzz around the technology and households started asking their plumbers about tankless water heaters. The consumer demand motivated plumbers to learn about tankless water heaters to keep their customers satisfied and distributors and retailers began stocking the product. Manufacturers emphasize that utility websites are often cumbersome to navigate and lack pertanint details. To counter act this an easy-to-find website and coordinated marketing campaign to enable customers and contractors to learn

about technology benefits, program offerings, and program requirements are valuable resources.

Distributors and manufacturers are attuned to opportunities to increase adoption of HPWHs in new buildings. New construction has been a successful market segment for other states, such as Wisconsin. All-in incentives (utility or federal) that offset a HPWH's incremental cost will be important in new buildings because builders tend to be price sensitive. Manufacturers have also suggested that emphasizing the improvement in HERS ratings for installing HPWHs could provide an additional incentive for builders to consider HPWHs.

Contractors and distributors suggest improved installer training is important for scalable adoption of HPWHs in Michigan. This training can eliminate the fear of the unknown for installers. Manufacturers expressed a desire to participate in utility-sponsored trainings on HPWHs. This allows manufacturers to provide training on the HPWH products, which they are experts on, and utilities can speak to the program design. Additionally, the trainings should include sections on the consumer experience with HPWHs, such as use of the water heater's phone app and settings. These factors can improve field performance and customer experience.

According to manufacturers, there are installation barriers that inhibit wider adoption of HPWHs in Michigan. First, HPWHs tend to be heavier than ERWHs. They may require two people to move into a home's installation location, which may impact installation costs. Second, HPWHs tend to be larger than the water heaters they replace. This may limit the potential in space-constrained installations, such as utility closets. In addition, a HPWH has air supply requirements needed for optimal performance. When the HPWH is installed in an enclosed location, adding vents or louvered doors may be needed for optimal performance. This could add installation costs. Manufacturers do not recommend stacking HPWHs in storage in a distributor or retail store stocking warehouse because their compressors are generally located on the top of the water heater. Although this may not be an issue with low volumes of HPWHs stored, it could create a scaling challenge to stock for wider adoption of this frequently emergency-replacement technology.

Finally, from a policy perspective, manufacturers emphasized that the MEMD's requirement that HPWHs must be 55 gallons or less to qualify for energy savings is problematic and misses the opportunity to encourage more efficient technology for homes with higher hot water demand. There are quite a few 65-gallon and 80-gallon HPWHs on the market that make sense for households needing additional capacity. However, in 2015 a new DOE regulation was put in place to essentially prohibit electric resistance water heaters over 55 gallons unless they were commercial. For this water heater category, the new federal baseline efficiency standard was set at a UEF above 2. Due to this higher baseline, in theory there would be fewer electric savings on the table for 65- and 80-gallon HPWHs if they were added as a program measure. However, installers have effectively found ways to circumvent the regulation and still serve the residential market with large commercially rated electric resistance tanks or multiple 50-gallon ERWHs or a combination of ERWH with a 50-gallon HPWH. The extent to which the DOE enforces compliance moving forward is uncertain as is the preferred approach to calculate savings if larger tank sizes are added to the HPWH measure. There is an inherent energy efficiency tradeoff at play given that a larger tank will enable heat-pump only mode to more

adequately cover a household's hot water demand but also the standby losses from the larger tank will be higher.

Ground Source Heat Pumps

Ground source heat pumps (GSHPs) have the potential to provide Michigan homes (single and multi-family) with significant energy savings and carbon reduction when applied properly. GSHP comes in several styles and sizes and back up heat can come from fossil fuels or electric resistance. Most closed loop GSHPs have the potential to operate at lower costs than high efficiency natural gas furnaces and boilers depending on the electric rate. In some cases, the supplemental heat from electric resistance strips goes unused in variable capacity systems that modulate. The Michigan-made add-on unit Well-Connect runs in conjunction with a furnace and can reduce homefossil fuel use for space heating by as much as 90%. Michigan has numerous examples of successful ground source heat pump installations for the State Capitol building and hotels in Lansing, to Detroit condominiums, and the Stump family's 100-year-old home in Lyons.

Manufacturers and local contractors report that new construction custom homes and major renovations make up most of today's GSHP installations. They report most customers forgo the addition of natural gas to their home or remove it completely for improved health, safety, and environmental reasons. Manufacturers and installers report adopters typically enter the conversation around GSHP system selection acknowledging that they could pay more to heat their home than if they used the most efficient natural gas equipment.. GSHP manufacturers and contractors indicate adoption in the renovation and replacement market is limited because of inequitable HVAC product promotion, increasing electric rates, and limited number of installers specializing in ground loops. Currently ground source heat pumps have a longer than normal (3 day) manufacturing time frame with an expectation of 17 weeks from order to delivery. This means consumers need to plan to order equipment well in advance of when it will be needed. This is mitigated by most installations being planned replacement and new construction opportunities and GSHP installers have brought in a small number of units to have on hand for emergency.

To ensure that both utilities and the product purchasers are happy with ground source heat pumps manufacturers and distributors indicate the MIHPC should increase education on the operational vs up fronts costs, reduce barriers found in program design and accessing qualified installers. Most qualified installers are in areas where delivered fuel is highly concentrated, but it is now of interest in major metropolitan areas like Ann Arbor and Traverse City where city wide sustainability goals and initiatives have been established. The barrier in city and suburban lots can be lack of space for horizontal loops which increases cost when vertical wells are used. In Metro Detroit limited numbers of qualified installers, along with incongruous existing home heating fuel type, and limited space for loops make it difficult. In the UP, barriers reported include lack of installers and high electric rates based on contractor and manufacturer comments.

Most ground source heat pumps are sold directly by the manufacturer to the dealer who is the installing and factory authorized contractor. Market actors have reported I&M's introduction of a distributor-based midstream incentive model is problematic for GSHP equipment which is

typically sold direct-to-dealer.[32] Distributor-based midstream incentives limit available equipment rebates to the brands sold through distribution channels. Therefore, a utility program is no longer brand agnostic and may even penalize some top-quality manufacturers. Ground source heat pump manufacturers and others face a major administrative burden to process midstream program reimbursements to dealers on behalf of electric and gas utilities across the country. For this reason, and to increase customer visibility, GSHP manufacturers and installers recommend utilities offer GSHP rebates downstream.

Customer education on GSHPs is the most important needed intervention according to the supply chain. Online materials should be easy to access and cover rebates and electric rates that can be used with GSHP as well as connect interested customers with qualified installers. Overviews of the different options and effects on operation costs significantly increase a consumer's willingness to accept higher upfront costs for greater comfort and lower operation costs. This will help make sure customers have a chance to learn about options before purchase. Supply chain actors support a designation for installers and recommend requirement for a Michigan Geothermal Energy Association (MGEA) or IGSPHA certification. Mailers to drive consumers to seek further information is the main suggestion to increase consumer awareness. In addition, contractors want utilities or the collaborative to provide consumer education to GSHP adoptees on operation tips that will help customers manage costs. For example, very energy conscious heat pump users have reported turning the circuit breaker for their backup heating elements off unless weather conditions are so extreme that the ground loop can't keep the home at 68°F. Other education after purchase could focus on operational strategies for precooling or preheating when a customer is enrolled in time-of-use rates.

Air-to-Water Heat Pumps

Air-to-water heat pumps are similar to ASHPs but use a refrigerant-to-water heat exchanger to distribute heat through a hydronic system. Some systems are split where the indoor unit contains the heat exchanger. Others are monobloc where all heat pump components are contained outside and require a hydronic loop that is anti-freeze protected. Air-to-water heat pumps are a recently introduced product to the US and Michigan. ENERGY STAR awarded air-water heat pumps with the Emerging Technology Award in 2019 and created performance criteria and a qualified products list.[33] Products from Chiltrix, Space Pak, and Arctic Heat Pumps are currently listed but we did not hear from market actors that these products are meaningfully sold in Michigan to residential customers. At this point, the product category has limited availability and use in Michigan. The Aermec system is available but is relatively complex to design and can have long lead times as it comes from Italy. Additional systems will soon be available from Enertech and Taco. These two systems feature a mono-block style design and will be slightly easier to design as they are sold as complete systems with only a few accessories.

Enertech has released robust online training covering their product and intends for most installations to occur in custom new construction and major renovations. The product offers

[32] Lennox, a major ASHP manufacturer, also deploys a direct-to-dealer model and faces similar challenges to participate in distributor-based midstream programs
[33] https://www.energystar.gov/about/awards/2019_air-to-water_heat_pumps

radiant distribution and hydronic air handlers as well as domestic hot water. The current target market is the western United States and New York. However, Michigan and the Midwest are being considered for product development soon. There are already skilled residential installers in the state following the product and working with Enertech for potential use.

Taco has held a few online product introductions for the System M which is made its introduction in October of 2022. System M is a Taco and Glen Dimplex joint venture, with Taco having the plumbing and hydronics specialties, and Dimplex having responsibility for the heat pump section. This product is similar to the Enertech system described above but it is only available in one size. That means this product will be for smaller homes or multiple systems would be needed.

According to manufacturers and contractors, for this product to gain momentum in Michigan it will need significant support in the form of rebates from utilities or the state to bring the upfront costs down. Research suggests air-water heat pumps are more energy efficient than their air-to-air counterparts. The suggested rebate amounts will need to be well over $1,000 as the product will have similar costs to a three-ton closed loop geothermal system. The ideal contractors to offer this product will be those with a strong understanding of the existing hydronic heating system design and installation as it is the distribution system and water temperatures that will be key to system performance.

RECOMMENDED HEAT PUMP MARKET INTERVENTIONS

Based on the market and program characterization above, we developed recommendations on further market interventions the MIHPC could consider as a group or that any individual MIHPC utility might incorporate into their research, pilots, or programs. Some of these recommendations are more immediately actionable than others but all of them support further heat pump education and market development efforts that would benefit Michigan residents and the heat pump supply chain to ensure the growth of heat pumps in the state is undertaken responsibly with positive outcomes.

Recommended market Interventions

- Heat Pump Contractor Designation
- Contractor Training and Education
- Utility Program Design and Incentives
- Workforce Development
- Emerging Opportunities
- Consumer Awareness Building and Education

HEAT PUMP CONTRACTOR DESIGNATION

While heat pumps themselves aren't a new technology, the latest technological advances have created a resurgence in their offerings, especially as cold-climate heat pumps have proven effective in colder climates like Michigan. As heat pumps are an emerging market, customers need guidance on which contractors to contact who have experience, proficiency, and confidence in the technology. To lift the market, utilities should coordinate growth of an established, early group of dedicated installers, generate consumer awareness and lead generation while driving leads to dedicated installers, creating a Heat Pump Designation and later potentially develop a bonus rebate, that only designated contractors can offer. Additionally, this designation would include a badge that contractors could use in their own marketing and be included on collaborative utility website contractor listings to differentiate the contractors within their territories.

The main goals of a designation are to:

- Capture early heat pump adopters
- Generate customer confidence in contractors

Table 14 Other Heat Pump designations from utility programs.

Organizer	Designation	Notable Benefits (Aside from Training)	Notable Requirements (Aside from Training)
MN ASHP Collaborative	Preferred ASHP Contractor Network	Gain leads, cobrand materials and promote endorsement	Virtual site inspection to evaluate installation practices and homeowner satisfaction Considering requirement for proper flaring tools and torque wrench for installing mini-splits as well as verification of proficiency in flare fittings and connections
Mass Save	Heat Pump Installer	Third-party rebate designee approval, expedited rebate payment, customer brochures and sales tools, e-newsletter, customer access to 0% financing	Preliminary plan that customer must use approved contractor for rebate starting in 2023 Certification of Cold Climate Sizing and Design Training by a heat pump manufacturer Completion of assigned cold-climate heat pump trainings via Mass Save Energy Efficiency Learning Center
Michigan Saves	Electrification Badge	Gain customer leads from badge recognition and MI Saves promotion of financing and electrification marketing.	To maintain badge, must install four heat pumps per year Considering annual spot-checks
Efficiency Maine	Residential Registered Vendor	E-newsletters, sales tools, access to leads from marketing, training scholarships	Customer must use registered vendor for rebate and financing eligibility Based on each installation crew

The MN ASHP Collaborative first launched and provided resources and trainings to contractors. As the utilities started promoting some of the heat pump resources to their customers, they got many complaints from customers that contractors didn't know what they were doing or were actively dissuading customers from ASHPs. With this feedback, they decided to implement a designation. It rolled out January 2022 and as of October 1, 2022 has 10 companies with 11 contractors. Instead of casting a wide net to get any and every heat pump installer, they worked within their network and utility networks to identify the high performers and targeted them with the designation. It's stringent – contractors are required to attend manufacturer trainings, ASHP collaborative trainings, provide licenses, and a QA site inspection by Collaborative staff. It's

meant to be stringent so that utilities can confidently provide referrals to contractors with the designation. Distributors were involved in the initial discussions to provide their feedback as distributors can be an important stakeholder to get buy-in from. The designation badge can be displayed on contractor sales materials and website along with utility contractor tools. Once the designation launched, they grandfathered in contractors who already participated in the trainings.

In our conversations with stakeholders, many have expressed support for this tactic as it ensures those contractors who are taking the time to learn and promote heat pumps are recognized. This also provides utility customers the benefit of feeling confident in which contractors can properly install a heat pump.

Since the Collaborative doesn't provide rebates or monetary incentives to contractors, the benefits of the designation early on could include:

- Leads through the website
- Badge for use on contractor's materials
- Administrative/application support
- Educational resources for customers
- Provide continuing education credits through trainings

Individual utilities could also provide benefits above and beyond what the Collaborative can offer, such as:

- Only contractors with the designation can install heat pumps through utilities' income-eligible programs
- Only contractors with the designation are eligible for utility rebates
- Enhanced rebates
- Bonuses

Not all contractors should be eligible for the designation. The purpose is to ensure that only contactors who are fully bought in and have proven credentials on heat pump technology are eligible. In review of the Michigan Saves electrification badge, (as of October 1, 2022), while 10 companies currently have the badge, only three list heat pumps as a service offering. The purpose of the Collaborative's designation would be to ensure that quality heat pump contractors are receiving it. To ensure quality contractors, the requirements for inclusion could include:

- Proof of manufacturer training
- Participation in MIHPC trainings
- Insurance requirements
- Applicable MI licenses
- Actively promotes heat pumps

- Customer satisfaction (at a later phase)

CONTRACTOR TRAINING AND EDUCATION

Training and education needed by Michigan HVAC contractors varies significantly based on geographic location, consumer demographics, and delivered fuel makeup. However, no matter where in Michigan, the most important question on distributor and contractor minds is how to ensure affordable heating for customers. This makes information on operational cost, rates, rebates and program requirements important. Distributors offer product training and contractors attend when there are changes or product additions. While no formal training plan was developed, we have a few suggestions to align training content with the needs of the market which currently includes novice and advanced installers. Local distributors and manufacturers signaled they would welcome inclusion of this content in their in-person classes in spring of 2023.

Existing plans for training content are in alignment with the needs of the market but two high-priority educational needs surfaced from our stakeholder investigation. First, stakeholders desire training that is inclusive of GSHPs. Second, the market desires education and resources on electric rates and operational cost comparisons. This finding is bolstered by Consumers Energy's pilot contractors interviewed who identified a key barrier to heat pump sales being the variety of electric rates and an inability to make accurate comparisons of operating costs for customers. Rate guidance and operational cost comparisons ultimately empower contractors to demonstrate heat pump affordability in their sales process with consumers.

To enhance MIHPC contractor training and education efforts, additional resources and educational opportunities should be created to boost awareness and confidence in heat pumps. It would be best to create a training plan before committing to the following possible enhancements.

Idea Exchange

The MIHPC can be a very valuable resource to manufacturers and distributors providing direct to contractor training. Idea exchanges are one-to-two-hour sessions with the lead trainers, sales managers, and territory managers for distributors, manufacturers, and manufacturer sales reps. These contacts lean on utility guidance to provide the minimum requirements for rebate eligibility across all avenues. This allows the territory managers to make the most appropriate suggestions when large projects are brought to them for bid. Many distributors have the potential to sway HVAC solutions for a variety of home types through contractor education. Distributors have noted that because utilities are planning for rebate programs in advance, they could provide distributors with some insight into the measures before the start of the new year to be sure they stock rebate eligible equipment, and the sales team is prepared with the corresponding value proposition.

Heat pump resources on rates, cost of heat, and controls

The stakeholder investigation revealed that the variety of residential rates make it complicated for contractors to explain operational costs and controls strategies. For example, one utility may have a time-of-use rate which incentivizes a customer to pre-heat or pre-cool. Standard rules of thumb for use of programable and smart thermostats for furnaces and boilers are not the same as they are for a heat pump. Utilities have educated about thermostat setbacks for years and now the new best practice of “set-it and forget-it” to optimize performance of inverter-based heat pumps (or slight alteration to accommodate time-of-use-rate schedule) presents a major educational barrier. A rate guide for the collaborative utilities, FAQs about heat pump controls and electric rates, or a service agent with knowledge on these topics would be helpful resources. Customers and contractors see the electric utility as the best resource to accurately verify the appropriate electric rate. Further, an online cost of heat calculator tool to compare operational costs of cold-climate heat pumps to other systems was also recommended by both distributors and contractors. One contractor indicated how an ability to compare operational costs in dual fuel systems based on switchover temperature would be helpful. All the resources described above would empower contractors as frontline comfort consultants and would empower consumers looking to educate themselves before and after purchasing a heat pump.

Product Ownership

In addition to contractor and consumer education on electric rates, operation costs, and control strategies, many distributors report a lack of contractor confidence in the product for heating. Many contractors who have purchased systems and used them in their own homes have gone on to become strong advocates for the technology. Four contractors interviewed from as far north as Marquette and as far south as Kalamazoo indicate that firsthand experience has made themselves and their partners heat pump advocates. To supplement the proposed training modules, the MIHPC could seek to strengthen contractor familiarity with heat pumps with a product ownership program that covers product cost and provides sizing, selection, and installation guidance for a heat pump installed for heating at a contractor’s home or office.

UTILITY PROGRAM DESIGN AND INCENTIVES

Program logic involves identifying and making interventions in the market where they are likely to influence the desired change. To manage resources, interventions should be directed to those most likely to have the greatest impact, balanced with interventions that are meaningful and necessary for achieving equity commitments. Market transformation, by definition, requires intervention throughout the market, and within utility program design, push-pull strategies are commonly used to contribute to a broader transformation effort. Utility programs offer a spectrum of financial and other incentives and services intended to motivate purchase of heat pumps as well as behaviors and practices related to design and operation. A summary of utility energy efficiency program interventions that apply to responsibly scaling heat pump adoption follows.

Utility-Sponsored Financial Incentives

The role of incentives in utility programs is to help overcome the first cost barrier of adoption, and more specifically to offset the incremental cost between a standard measure and the potentially greater cost of a specific measure that serves the program goals.

Downstream incentives typically require the customer to complete and submit an application or provide or use a program coupon after a piece of equipment is purchased. Rebate programs might require proof of installation and some rebate programs include a quality assurance inspection to verify proper installation. The value of the incentive can be prescriptive (fixed) or custom (calculated based on a formula that values a certain outcome, such as performance). As one example, insights from the Michigan market and other programs across the country have shown that utility ASHP prescriptive incentives should meet a minimum threshold of $1,000 to drive market change.

Discounts are another type of downstream incentive that make the customer payment instant at the point of purchase. Accordingly, instant (or “point of sale”) incentives are an important tool in the program toolbox particularly whereas the incremental cost is relatively significant. This method eliminates the waiting time of traditional rebate fulfillment, which low income households or people having financial burden typically cannot absorb. HPWH retail coupons are effective incentive tools for the meaningful share of customers who self-install the equipment.

Upstream incentives are targeted toward manufacturers, and midstream incentives are targeted toward retailers, distributors, and contractors/installers. Both are a significant part of an overall utility program approach to increase heat pump adoption. This is because manufacturers, distributors, retailers, and contractors/installers play uniquely influential roles on equipment performance, stocking/inventory, and installation quality. Installation contractors, specifically, are typically the greatest influence on a customer’s HVAC decision as they serve as comfort consultants and recommend equipment. As described earlier, the Michigan GSHP market indicated an aversion towards midstream or upstream incentives due to the administrative burden and some ASHP distributors also are not active proponents of the midstream incentive model.

Offering midstream and downstream incentives within the same heat pump program can be an effective strategy to cover multiple bases. It is also good customer service and inclusive for all rebates to at least be accessible downstream to a customer who may not go through conventional sales channels or participating distributors or retailers in a utility program.

Financing made available through utility programs is an incentive mechanism to overcome first cost barriers and make a customer’s project more seamless. Loans, or other novel financing products, can help a consumer make the decision to install a heat pump especially when stacked with program elements like cash incentives, information, and qualified contractor network. Specialized terms and processes (like longer and on-bill payback, lower interest rates, and waived credit checks) for a financing option situated in the utility program can also be a resource for customers who cannot get access to market rate financing. In utility program design it is important to seamlessly integrate financing offers with other customer-facing program components so the program overall reduces the hassle barrier and does not heighten

it. One-stop approaches where the consumer can see and access the entire stack of program interventions that facilitate their adoption work best.

In the geothermal market, utilities could offer loop installation services, provide community loops, or even offer loop leasing programs to support their customers as all the equipment and specialized installation knowledge is already with their institution. A ground source heat pump is often cost comparable to a high efficiency furnace and air source heat pump or boiler however it is the cost of the ground loop that gives most customers sticker shock. As a rule of thumb, the cost for a loop can add at least $12,000 to the cost of the project for a four-ton system. This closed loop cost premium drives consumers seeking to minimize upfront cost to select open loops which are prone to greater maintenance issues and operation costs or to air source heat pumps which also entail higher operation costs. ComEd and Michigan electric cooperatives offer loop incentives with ComEd offering up to $6,000 per home.

Heat pump and other programs have a wide range of practice concerning incentive placement; however, midstream programs offer little clarity about how the benefits accrue overall. In refining the program design, the sponsor should consider whether incentives paid to contractors remain fully with the contractor or whether there is a preference or requirement that the contractor pass through the incentive to the customer fully or partially and if partially, in what amount. If a contractor receives and keeps the full program incentive, the designer should ask whether that practice is achieving the greatest market impact possible (are the most heat pumps deployed through contractor incentives?) or whether passing along the full or partial incentive to the customer would contribute to greater market transformation. The design should also answer this based on evidence supporting the theory. Additionally, a program sponsor should consider how a distributor SPIFF or cooperative marketing may progress market transformation and be integrated.

Utility Trade Ally Management and Customer Support

A successful utility program incorporates a healthy trade ally program. While some utilities invest in recruiting a network of contractors that are eligible to participate in their EWR programs, others have an open network that allows any contractor to participate. Ensuring that contractors have enough resources and support from the utility is important when offering rebates on a relatively new technology, such as heat pumps. Customer support is also crucial so that if a customer has a question after becoming aware of the program, they can easily get their question answered. Not only does it encourage program participation, but it can also help customers feel more satisfied about their utility.

Efficiency Vermont formed a team of subject matter experts, for example, who field questions from and offer guidance to the market. Whereas consulting energy advisors are staffed in many commercial energy efficiency programs, a residentially-focused team of this nature is less common. A consideration for heat pump program design is building on the example of Efficiency Vermont to create a “Heat Pump Desk” of experts who are trained both technically and programmatically, and can serve as a hands on navigator or concierge that connects consumers, contactors, distributions, or others with needed resources and information. DTE has

already invested in home comfort concierge service which provides guidance on heat pump installations.

Additionally, utility program-enabled dialogue within the network of contractors and distributors can help identify and address challenges relatively quickly and serve as space to share information about emerging trends, program changes that affect the market, lessons learned, and more. A trade ally network forum can also be a space where the network discusses and provides input on qualifications and standards contractors should meet to be included on the program's qualified contractor list.

Finally, electric EWR programs need to stay on top of the source of new savings. Central AC replacements make up a large portion of current EWR residential HVAC savings but their share of sales are likely to shrink in favor of dual fuel ASHPs due to new federal incentives, updated ratings, and increased market appetite. To counteract this loss of savings in the short-run, existing measures for electric savings such as whole home dehumidifiers may be needed. In the long-run, issues regarding baseline equipment and fuel switching will need to be addressed so that heat pumps can more meaningfully be incentivized.

The challenge of defining air source heat pump equipment qualifications

A key component of any energy efficiency program design is to define equipment qualification criteria. ASHPs present unique challenges in rating system heating performance since their efficiency and capacity decline as outdoor temperature declines and there is an inherent tradeoff in the maintenance of heating capacity and heating efficiency at low temperature operation. Currently, programs predominantly rely on seasonal energy efficiency ratio (SEER) and heating seasonal performance factor (HSPF) to define efficiency. Capacity is typically defined by programs as the cooling capacity at 95°F. Increasingly, programs have relied on the NEEP cold-climate ASHP list which sets a requirement for a COP of 1.75 at 5°F but lacks a cold-climate capacity requirement. In 2022, ENERGY STAR version 6.1 addressed this shortcoming and expands the definition of a cold-climate heat pump to also maintain at least 70% of its heating capacity at 5°F compared to standard rating at 47°F.

Ratings impacting ASHPs are rapidly evolving. As discussed earlier, SEER2 and HSPF2 will replace the old SEER and HPSF metrics starting in 2023. In addition, the Environmental Protection Agency (EPA) has signaled that it recognizes dual fuel heat pumps as the next step for retrofits in existing homes and expects 2023 to be the last year any central air-conditioners will be eligible for the "most efficient" ENERGY STAR criteria.[34]

Fundamentally, the problem with HSPF as an indicator of heat pump efficiency lies in the fact that the rating is derived from static test conditions that do not account for variable speeds of inverter-based equipment, the rating only refers to Climate Zone IV so misses two colder climate zones in Michigan, and HSPF only provides heating efficiency at 47°F.

[34]https://www.energystar.gov/sites/default/files/asset/document/ENERGY%20STAR%20Most%20Efficient%202023%20Stakeholder%20Comment%20Matrix_1.pdf

The Northwest Energy Efficiency Alliance (NEEA) has conducted robust research on the performance of ASHPs and in recent modeling determined that low-load efficiency appears to be the most important metric in terms of overall seasonal heating efficiency of an inverter-driven heat pump.[35] This means the COP at minimum capacity at 47°F is a major driver of seasonal efficiency and ultimately operational costs in the home.

Efforts to improve identification of heat pump performance are ongoing and the landscape of ratings will likely continue to evolve to better capture the diversity of equipment and its efficiency and capacity profiles at different outdoor conditions. One effort to monitor is the Canadian Standards Association (CSA) EXP07 test procedure which provides load-based and climate-specific testing. Preliminary tests have shown wide variance between HSPF and the CSA EXP07 metric which better reflects real-world conditions and systems with variable-speed compressors.[36]

Given the challenges described above in identifying real-world ASHP performance and the inadequacy of currently available ratings, to the extent possible, rebate qualifications should be simple and consistent across utilities.

Braiding federal heat pump incentives

Whereas utility energy efficiency program experience gives a robust framework and methods for accelerating heat pump adoption, new federal programs and funding made possible through the Infrastructure Investment and Jobs Act (IIJA) and Inflation Reduction Act (IRA) create opportunity to transform the heat pump market. In designing utility programs in the medium term, aligning and complementing interventions with those made possible by federal funding can optimize heat pump deployment.

Coordination options may include an awareness campaign with utility customers and the trade ally network that socializes what federally funded programs like High-Efficiency Electric Home Rebates (HEEHR) and Home Owner Managing Energy Savings Rebates (HOMES) include and how customers and contractors can stack the benefits with utility offers and tax credits available through 45C, 45D, and 45L of the Internal Revenue Code. Another option for coordinating pathways is to identify and partner within the state to take advantage of the State Based Home Energy Efficiency Contractor Training Grants authorized in IRA. This program has $200 million in funding that will be allocated through State Energy Offices specifically for efficiency and electrification contractor training. An important consideration in coordinating utility and federally funded programs is making sure that program requirements for the consumer in one program do not conflict substantially with those of the other program, thus preventing ability to stack and optimize the programs overall.

[35] https://neea.org/resources/variable-speed-heat-pump-product-assessment-and-analysis
[36] https://docs.lib.purdue.edu/cgi/viewcontent.cgi?article=3455&context=iracc

WORKFORCE DEVELOPMENT

The HVAC workforce is aging, and it is challenging to find enough trade allies to meet current and expected demand for heat pump and related technology installation. Most contractors currently recruit and train new employees in-house. While distributors serve as the primary local source of continuing training and education on heat pumps, manufacturers offer new technician training programs which typically run four to six weeks and require in-person attendance. One of the three schools interviewed indicated they also work closely with a distributor who has donated equipment to their training lab and frequently visits the school to provide training to students. Below we describe a few current community college and trade school perspectives and offer ideas on how to drive deeper enrollment and alternative educational pathways to develop the new heat pump workforce.

In general, new-to-the-trade employees are not readily available and there are current challenges to school enrollment. We discovered one school has temporarily stopped their HVAC program due to lack of enrollment. One school is enrolling students, but some applicants are not able to attend due to lack of financial resources. A third school has created an effective outreach and job placement program and reported full class schedules and a waiting list for new students.

Insights from other markets have revealed that online technical learning platforms can help accelerate the development of new technicians. Faraday Careers matches students with companies who pay for training to eliminate the need for a new worker to go into debt and commit to hiring upon successful completion of the program. As another example, in 2022, the certification body NATE launched the NATE Training Academy in partnership with Interplay Learning to offer online virtual reality-based training with heat pump manufacturers. These examples illustrate possible alternative pathways than the traditional community college or trade school route to accelerate the development of new HVAC technicians.

Based on information gathered, below are a few ideas of how the MIHPC, individual utilities, or other organizations could support development of the heat pump installer workforce.

Recruitment in high schools and communities

Upon graduating high school, figuring out what is next can be one of the most difficult decisions that a person makes. Few students are aware of the number of green trades that are evolving. High school outreach that highlights career paths in the green trades such as solar, wind, HVAC, plumbing, and electrical benefits contractors, utilities, the employment landscape, and economy overall.

Interest in trades employment has fallen in the past few decades and the existing workforce aging. Market actors interviewed who are trying to recruit new employees have found that the trades are often thought of as grueling jobs. However, increasingly, the tools of the trade are digital technology and remote diagnostics rather than physical tools to install equipment and make repairs. The trades also are resilient and reliable sources of income and rewarding in that a worker builds something or improves someone's quality of life. Most roles in the trades allow for travel and problem-solving challenges.

MIHPC resources toward a high school outreach program can help create a pipeline of heat pump installers. Highlights of the outreach program could include:

- An informational campaign that raises awareness of the job potential and its range of benefits
- Identifying high schools in the MIHPC footprint and any known instructional contacts there
- Creating a partnership with curriculum leads, teachers, and others who deliver instruction most closely related to the trades and who are involved with job placement/preparation
- Collaborate to develop and deliver a preparatory program at high schools where there is greatest interest (e.g. an educational champion) and identify pathways for post-secondary training and connecting students to those pathways
- Measure and socialize job pipeline results that can reinforce the program (e.g., have alumni revisit to share their insights about the job as guess speakers, create day-on-the-job experiences for students, and inspire incoming students in the high school preparatory program)

Workforce development partnership roundtables

Contractors are always looking for their next new employee. Trade schools have mixed experiences with recruitment and labor development. Distributors are willing to invest in the development of new workers. Creating a venue for collaboration and further development of ideas to replenish the work force would give space to highlight needs and barriers and share lessons learned.

MIHPC sponsorship of a partnership roundtable series can facilitate an ongoing alignment between the key market actors. Approach to the roundtable series could include:

- Identification of stakeholders
- Professional planning and facilitation of meetings
- Strategic planning at the state and/or local level
- Documentation and dissemination of findings and directional ideas/agreements for action and funding sources
- Optional maintenance of a discussion thread or informational site where the stakeholders involved can share questions, insights and answers, trends, concerns, materials, etc.

Mobile learning lab for students and contractors

One of the more successful trade schools has said they are at full enrollment and have a waiting list for new students. They also revealed that much of their course work takes place online. Lab space shortage is currently their greatest challenge.

To build on success where it is already occurring, MIHPC resources could potentially support a mobile learning lab trailer for hands-on training. The mobile learning lab would allow for more students to engage in laboratory style training with the added benefit of greater mobility of the

training resources. These students could complete course work remotely and get hands on laboratory experience at other remote sites. A mobile learning lab could also support existing contractors by bringing convenient opportunities for hands-on learning.

Federal Enablement for Workforce Development

Several programmatic and funding opportunities have been enabled by the Infrastructure Investment and Jobs Act passed in 2021 and the Inflation Reduction Act passed in 2022. Both have a strong focus on jobs development with specific opportunities for non-federal jurisdictions and private entities to advance contractor training for energy efficiency and efficient electrification. MIHPC and utility coordination with the designated state energy office, other state agencies, and public and private partners can help realize benefits from these programs and funds while meeting the core goals of the coalition. Michigan has been actively planning and prioritizing these federal opportunities, making it an ideal time to further progress on joint goals regarding workforce development for heat pump installers. Because utilities have unique insights and relationships within their territories regarding consumer energy behavior, market actors, economic development, and environmental justice considerations, collaboration on these federal funding opportunities is also an opportunity to fulfill workforce development aspects of the Justice40 commitment.

EMERGING RESIDENTIAL HEAT PUMP OPPORTUNITIES

Contractor business model development

While outside the purview of EWR, the advent of increased and sustained federal investment in rebates and tax credits for high-efficient electric technologies has created new business opportunities for decarbonization solution providers. One large Michigan contractor suggested that in the wave of federal investment they may move towards a heat pump only model and others have incorporated deep retrofits which include weatherization into their services.

A general contractor who specializes in decarbonization may deliver all the services (HVAC, insulation, air sealing, plumbing, and electrical) themselves or use subcontractors for some of the trades. A study by the Heating, Refrigeration and Air Conditioning Institute of Canada explored the “hard” vs. “soft” barriers for Canadian HVAC contractors to do more to support deep energy/carbon retrofits.[37] Further market research could be beneficial to determine opportunities to empower residential contractors in appropriate local markets in Michigan to incorporate decarbonization into their business models as a sales approach and possibly expand services to meet ensuing customer demand. If implemented carefully, the MIHPC or individual MIHPC utility member trade ally and customer engagement could support this nascent business model.

[37] https://www.hrai.ca/uploads/userfiles/files/2021%2005%2031%20--%20HRAI%20Final%20Report.pdf

Heat pump connected diagnostics

Field studies have shown that heat pumps often fall short in terms of full utilization and operation at design efficiency due to failure to properly configure and commission them at the time of installation. Issues with refrigerant charge and system airflow alone have been shown to reduce the efficiency of the average system by five to 10 percent[38], and a recent field study in Minnesota showed that one in six systems would see a performance improvement of 25 percent or more if properly commissioned.[39] Moreover, many contractors are unfamiliar with how to appropriately size and configure cold-climate heat pump systems—or have outdated notions that are not applicable to current variable-speed equipment. Mis-sized and mis-configured systems can lead to under-utilized equipment that fails to meet its savings potential simply because it does not operate for as many hours as it could. At the same time, research has shown reluctance on the part of contractors to engage in utility quality-installation and quality-maintenance programs for residential HVAC because the reporting requirements are perceived as onerous and the rewards low, especially given that most purchasers of these systems are completely unaware of the need for proper field commissioning.[40]

A new class of third-party, connected “smart tools” and connected apps (such as the iManifold and MeasureQuick) for commissioning residential heat pumps and air conditioners has the potential to significantly reduce the incidence of mis-configured and mis-tuned systems. In addition, some manufacturers (such as Daiken) have begun to embed diagnostics and fault-detection directly into their HVAC product lines, offering the potential to commission these systems directly. While current reporting and tracking features are limited, these tools/diagnostics present the opportunity for performance and utilization reporting. These advances offer a potential win-win-win scenario: easier commissioning and fewer callbacks for installers; improved efficiency and comfort for purchasers; and increased energy savings and better documentation of proper installation for utilities. In recognition of this potential, the Pacific Northwest National Laboratory and the DOE have launched the Smart-Tools for Efficient HVAC Performance Campaign (STEP) to promote the use of connected diagnostics for residential heat pumps. Additional research on the potential of connected diagnostics to benefit MIHPC utility initiatives related to air source heat pumps in Michigan (both embedded and third-party) would be valuable.

Micro 120V heat pumps

Micro heat pumps are an emerging heat pump category which feature an inverter-driven compressor, a packaged form factor that does not require evacuation or charging of refrigerant and can operate on a shared 15A 120V circuit. These heat pumps also present an opportunity for do-it-yourself installations. Multiple manufacturers such as Midea and Gradient are currently developing cold climate versions of their technology, but Gradient’s initial product already works down to 17F.

[38] https://www.osti.gov/servlets/purl/1670423
[39] https://mn.gov/commerce-stat/pdfs/card-improving-insullation.pdf
[40] https://mn.gov/commerce-stat/pdfs/card-improving-insullation.pdf

The Northwest Energy Efficiency Alliance (NEEA) is conducting a small field study which will cover questions such as what to do with the defrost melt water, customer expectations and perceptions, and how customers will install and use this product in their homes. NEEA will also gather data to determine how effective the mini heat pump is at displacing other heating or cooling sources in the home. MIHPC member utilities may benefit from closely monitoring this versatile heat pump solution and considering a pilot or field test in their service territories.

Midwest 120V HPWHs

Consumers Energy along with other funders in the Midwest are currently conducting preliminary research on the emerging plug-in 120-volt heat pump water heaters (120V HPWH). This design can enable plumbers to simply plug the HPWH into a standard outlet and avoid costs and labor associated with rewiring or upgrading the electric panel, which can become prohibitively expensive for households. Retrofit customers that are interested in switching from a gas-fired water heater to an efficient electric option are target candidates for this technology.

Due to its lower input power, the 120V HPWH may reheat water slower than the customer's replaced water heater. To mitigate the impact of a slower reheat, manufacturers have installed mixing valves that allow households to keep their storage tank hotter than the water delivered to their faucets. This increases the amount of hot water that the water heater can provide to the home. They also recommend larger tank sizes to reduce the chances of households experiencing hot water shortages.

Rheem is the only manufacturer with products currently available, but they are under development by three other manufacturers. The product has been field tested in warmer climates like California or the sunbelt region, but not with the colder groundwater temperatures typical in Michigan's climate. Field testing in Michigan would be an important step for determining if this product is a good option for certain Michigan homes.

Community Geothermal

Common ground loop infrastructure can improve cost-effectiveness of ground-source heat pump installation and can take advantage of heating load diversity among buildings to enhance overall system efficiency. Community geothermal provides a viable pathway for existing combustion-based district systems to decarbonize with several successful examples of university and corporate campus projects meeting carbon goals. Community geothermal projects offer pathways to lower operational costs even compared to natural gas as demonstrated in the case of a project for the town of West Union, Iowa.[41] Due to this potential to minimize operational costs and the need for skilled labor for installation and operation, community geothermal solutions hold promise for both equity and labor benefits. A variety of business models exist for community geothermal and utility pilots are underway in the Northeast. To facilitate broader Midwest activity and information sharing surrounding this topic, the Midwest Building Decarbonization Coalition launched a Clean Heat Infrastructure Accelerator that is open to participation from a variety of stakeholders. The MIHPC may find it

[41] https://energydistrict.org/2021/10/wed-wraps-up-west-union-geothermal-project/

valuable to participate in this initiative and explore opportunities to support the community geothermal market.

CONSUMER AWARENESS BUILDING AND EDUCATION

A key element to drive any product or service in the market is consumer awareness. Industry reports show that consumers often have a poor understanding of HVAC systems and will prioritize function and first cost unless readily and quickly educated on tangible benefits of system choices. While we can start to influence this reality by working with contractors, we know that with the internet, consumers do a lot of their own research and education. Manufacturers have also highlighted how utilities can play a pivotal role in consumer awareness building. With this backdrop in mind, we would recommend implementing a coordinated consumer awareness campaign to close this knowledge gap with consumers and increase sales of heat pumps throughout Michigan. By communicating with both consumers and contractors we can most effectively build interest and engagement in the market. Below are several recommendations for ways to build consumer awareness around heat pumps and help drive demand for the technology in the market.

Equip consumers for success: To best support the consumer, we propose building a series of resources to help demystify heat pumps, both from a purchase decision perspective and from an ownership perspective.

The first key recommendation before talking about the resources themselves is to ensure both contractors and customers can easily understand and navigate the available utility rebates, rates, and programs. We heard in the manufacturer and contractor interviews, that it is hard to navigate utility websites to learn all the nuances available in Michigan around heat pumps and heat pump rebates. The best way to ensure impact is to be clear and provide a resource to reference. We recommend adding a page to the Michigan Heat Pump Collaborative website that breaks down all the various heat pump programs available to customers, from residential to income-eligible to multifamily and beyond, and link to the relevant information on the individual utility websites. This page could also help break down the differences between different types of electric rates that might impact a customer's experience with a heat pump.

Informational & Technical Resources: Residential customers typically do not have the time nor the expertise to take on complicated energy projects on their own, especially ones with a high upfront cost. Technical assistance from the utility and or the MIHPC can help customers mitigate these barriers and thereby increase the number of heat pump installations. Technical services can range from the provision of easy-to-use project calculators that help customers understand costs and benefits of projects and equipping customer care call centers with readily available facts to frequently asked technical questions, to teams of subject matter experts that can aid in project specification, market connections, and other guidance.

Some additional resources we recommend that would support the consumer journey:

- Case studies or testimonials from other consumers. These could be simple fact sheets but would be most impactful if presented as a video. Hearing real stories from real people is more impactful than reading about it.

- Educational infographics to break down the operation and function of a heat pump for a consumer.
- Short and simple one-page fact sheets that break down the different heat pumps and when they might be right for a particular consumer's situation.
- A contractor search tool to help customers find a knowledgeable heat pump contractor quickly and easily. For example, this resource could include ways to recognize contractors who have completed MI Heat Pump Collaborative's training.
    - The Collaborative will be highlighting contractors who go through its training and obtain the designation. The sponsoring utilities should ensure their own websites include this list, or link back to this page.
- Heat pump owner's guide. This short guide could help consumers get to know their heat pump after installation and teach them best practices to get the most out of their new system. This could include things like operational tips and tricks, how to address common concerns, and when to contact your contractor.
- Electric rate guide. This would help distributors and contractors assist customers in selecting the right heat pump for them, capturing the nuances of each utility's rate design.

Leverage existing awareness campaigns: The simplest way to begin reaching consumers directly with information about heat pumps would be to leverage any existing collaborative utility campaigns already in the market. If possible, short educational topics could be included in rotating campaign messages, or new materials like infographics or video testimonials could be used within existing campaigns. This can also include leveraging existing utility opportunities like customer newsletters, bill inserts, emails, and social media.

Build a targeted awareness campaign: The next step to driving impact and building consumer awareness would be to design a targeted campaign around heat pump education and awareness. Leveraging existing customer data and research completed during this project to target single-family residential electric heat and propane customers, as well as reaching master-metered and low-income electric baseboard multifamily buildings. Messaging should be highly educational, helping to demystify the technology with consumers, and could utilize additional market research from similar markets to inform our final messaging. This campaign would utilize the consumer resources mentioned above to further support market communications. As with any campaign, it is important to identify and implement a strategy for how any customer leads will be collected and shared with a contractor network. This could be done either by having customers reach out to the contractor network directly or having call-center staff collect leads to connect with contractors.

While the collaborative can serve as a central resource for consumers, education and awareness campaigns are important interventions within utility programs, in addition to the collaborative's efforts, because they help overcome information barriers. Many customers still lack basic information about their current energy consumption and equipment, and what their replacement options are. Program information on websites, social media, newsletters, bill stuffers, relayed through trade ally communications, and other channels and tactics help

customers understand heating and cooling options and the benefits of heat pumps. General marketing and promotion that increases visibility of the program (i.e. without extensive explanation) complements substantive information and complements an awareness campaign's effectiveness in overcoming the information barrier.

All elements detailed here can be implemented separately but would be more effective if implemented together. Before any consumer awareness strategy is implemented it will be key to utilize existing research to inform the audience and messaging. The Collaborative should also coordinate with current program implementers to ensure any communication around rebate programs is clear and accurate, as well as align with all market stakeholders before launching any campaigns.

CONCLUSION

Inflation Reduction Act (IRA) funding is a catalyst for new markets for heat pump adoption. As heat pump technology gains traction in marketplaces across the United States, the MIHPC has taken important steps in ascertaining how Michiganders can benefit from potentially adding heat pumps into their decision-making processes. One significant factor in customer decision-making is the availability of information through a trusted and educated contractor network. What are the barriers to contractor engagement with heat pump technologies in Michigan? As an educational initiative at its core, the MIHPC took the first step to educate itself on the state of the heat pump technology market. Based on research outcomes, it is clear that the utilities within the collaborative, and Michigan as a whole, are at a tipping point to transform the heating and cooling market with heat pumps. Identified challenges align with many of the findings from the February 2021 Michigan Power Grid New Technologies and Business Models working group findings, such as lack of customer education, high installed costs, and limits on heat pump rebates for fuel switching.[42] As an educational initiative and forum for the exchange of utility program best practices, the MIHPC marks a significant milestone towards statewide collaboration on heat pump implementation strategy.

Utility pilot work, started in 2020, has laid the groundwork to move this market with newly designed programs that can have meaningful impact. Considering prior research, pilot efforts, and other utility-focused work in this market, many key takeaways can help set the stage for future program enhancements, contractor education, and customer empowerment. All three segments need to be aligned for heat pumps to be recognized as a viable alternative to mainstream residential HVAC systems. They include:

1. Utility programs and rebate offerings that offset the initial capital expense and higher costs of heat pumps installations.
2. Contractor education on proper heat pump applications, rate navigation, and business model adaptation.

[42] Further insights were outlined in the final staff report published in December 2021. https://mi-psc.force.com/sfc/servlet.shepherd/version/download/0688y000001jEwjAAE

3. Customer empowerment for their decision-making processes, understanding the benefits, contractor experience, and heat pump operation once installed.

With the passage of the IRA in 2022, this MIHPC effort is even more important. Utility customers will continue to hear more about heat pumps with the tax credits available and as states start receiving funds for incentives. Consequently, contractors will be asked by their customers about heat pump installations. Those contractors who are early adopters of this technology and its customer benefits will build IRA tax credits into their business model and quickly gain traction in the marketplace. Utilities will need to determine how to best braid their current programs with the IRA so that their customers can seamlessly take advantage of these offerings. Education and awareness efforts will be important so that each market actor understands their next step; utilities to promote their programs, contractors to purchase heat pumps from distributors and push customers to buy them, and customers to ask for them.

The IRA provides an immediate opportunity to educate the market on different heat pump applications. While much of the education and awareness has focused on air source heat pumps, our research has shown a wider opportunity to educate contractors on other types of heat pumps. Ground source heat pumps have had good uptake in some utility service territories like DTE, while a lack of contractors in UPPCO's territory has rendered the technology nearly non-existent in the past few years. Providing education and workforce development opportunities could help expand the ground source heat pump market.

Understanding the nuances of utility program design that makes it easy for customers to participate will be key for utilities to increase EWR program participation and reach their decarbonization goals. Contractors will need to understand the value proposition heat pumps offer to homeowners no matter the fuel type of their current heating system. Since utility EWR programs are constrained by fuel-switching requirements, outreach to contractors and customers has had a mixed level of support and success. If enabled for rebates, dual fuel heat pumps could provide a gateway for utilities to encourage broader heat pump adoption as they continue the current fuel source for use should the temperature drop below the point where a heat pump is most efficient.

The MIHPC educational effort will extend beyond the initial four collaborative utility investors; it will impact all of Michigan. Contractors tend to provide services in more than one utility service territory. Electric cooperatives and municipal utilities will also need to ensure their programs are easy to understand and participate in so that contractors can confidently provide incentive information to customers. Awareness and education campaigns will also overlap with service territories, thus, ensuring that the message is consistent across the state is highly important. Lastly, working with the various heat pump stakeholders' groups and solidly reinforcing the capabilities and benefits of heat pumps through multiple channels will offer Michiganders sound energy choices for years to come.

APPENDIX

APPENDIX A: NON-GAS SPACE HEATING MAPS

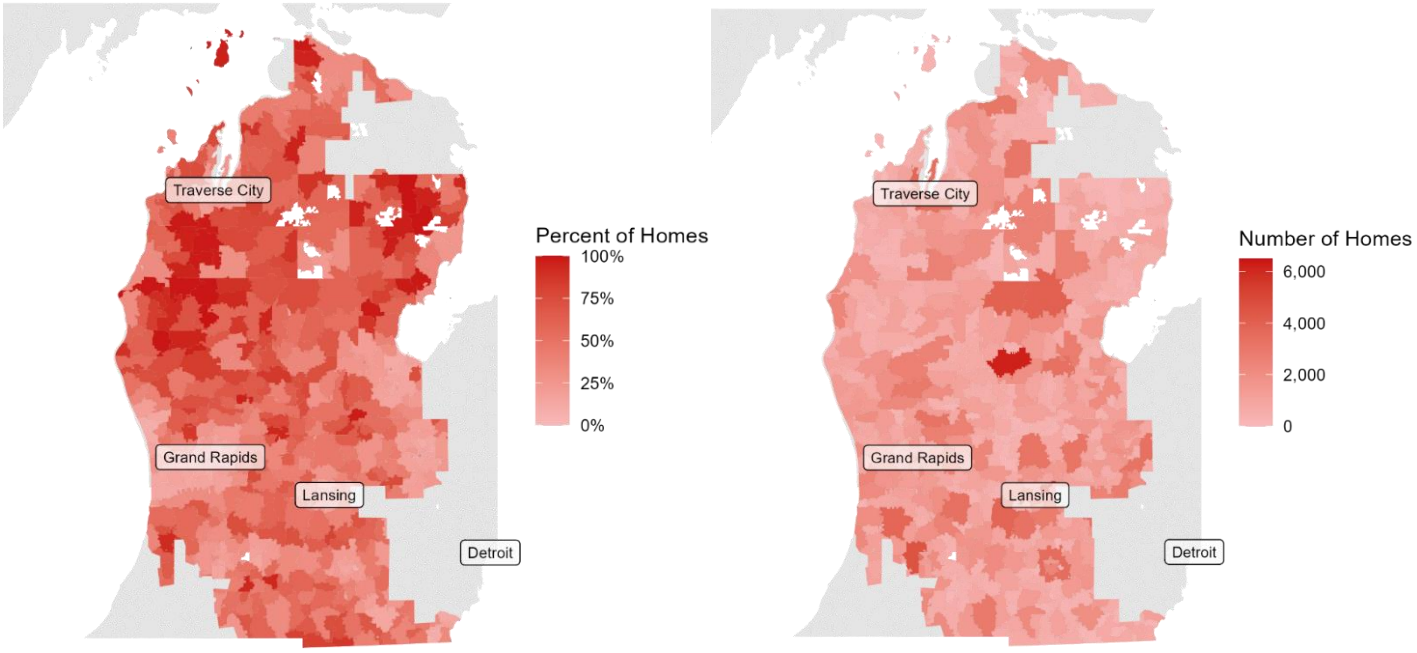

Figure 21. Prevalence (left) and number (right) of homes that do not heat with natural gas in Consumers Energy service territory

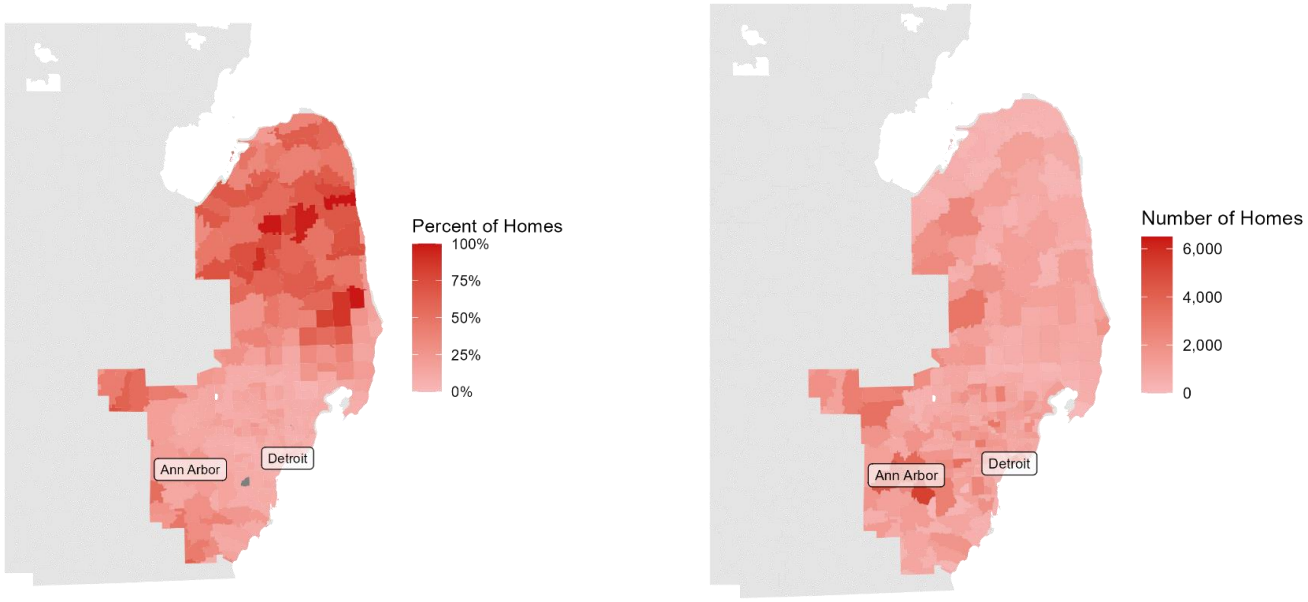

Figure 22. Prevalence (left) and number (right) of homes that do not heat with natural gas in DTE service territory

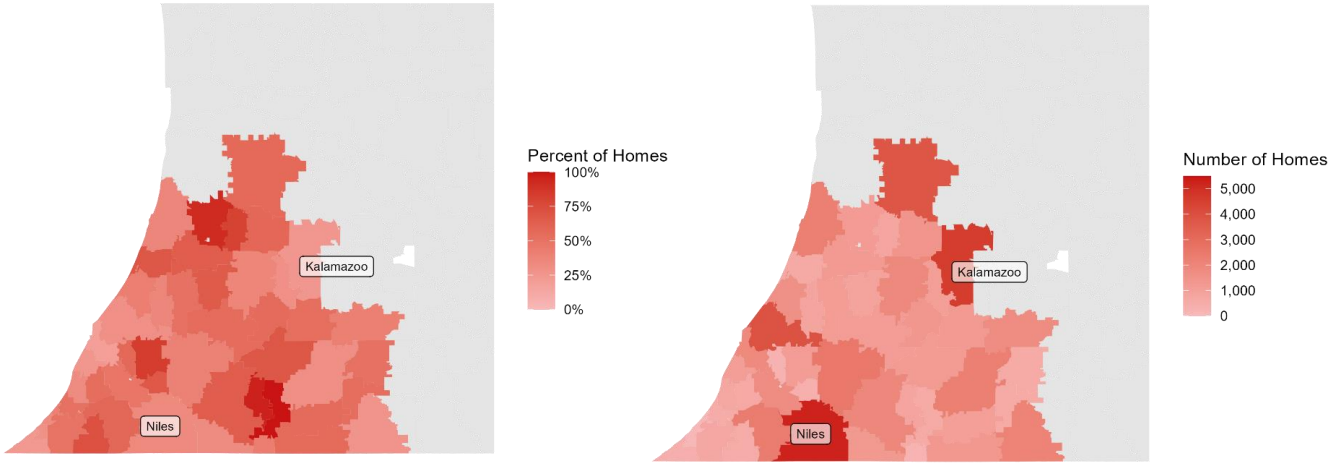

Figure 23. Prevalence (left) and number (right) of homes that do not heat with natural gas in Indiana Michigan Power service territory

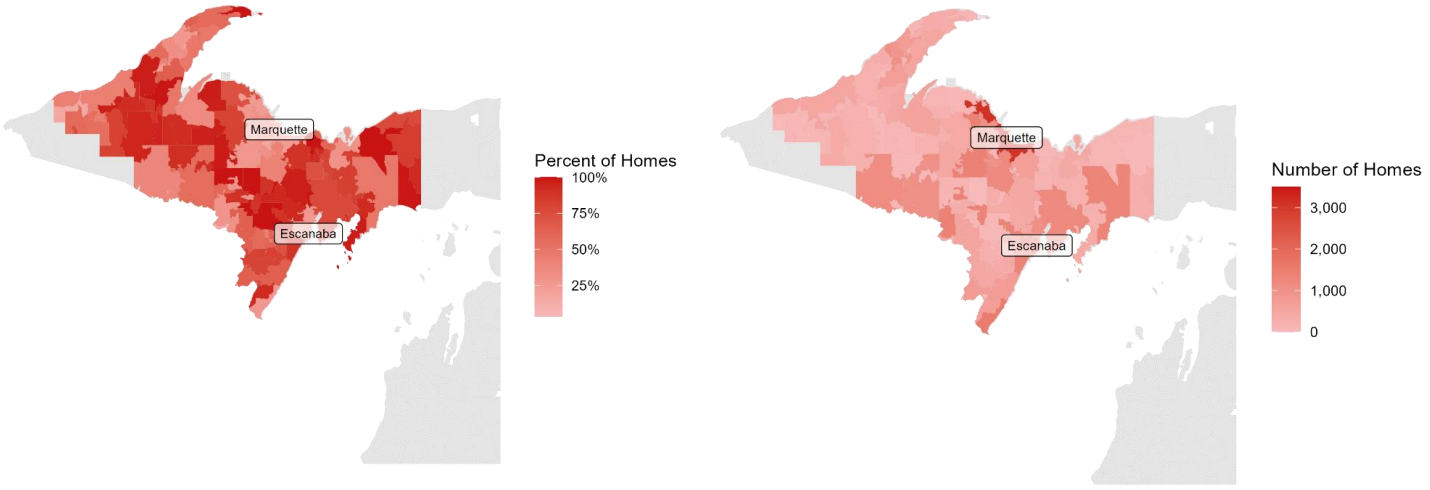

Figure 24. Prevalence (left) and number (right) of homes that do not heat with natural gas in UPPCO service territory

APPENDIX B: OTHER UTILITY HEAT PUMP PROGRAM DESIGNS & INCENTIVES

Table 15 2022 ASHP Rebate Programs

2022 ASHP Rebate Program	Measure	Qualifying criteria	Incentive
Cloverland Electric Cooperative	Ducted or dual fuel heat pump	Tier 1: 15 SEER 8.5 HSPF Tier 2: NEEP Listed $1,500	$1,000 $1,500
	Mini-split or multi-split heat pump	Tier 1: 17 SEER &9 HSPF Tier 2: NEEP Listed	$900 $1,400 Indoor unit: $100
Great Lakes Energy	Ducted or dual fuel heat pump	15 SEER 8.5 HSPF	$1,000
	Mini-split or multi-split heat pump	17 SEER 9 HSPF	Outdoor Unit $900 Indoor Unit $100
HomeWorks Tri-County Electric Cooperative	Ducted or dual fuel heat pump	15 SEER 8.5 HSPF	$1,000
	Mini-split or multi-split heat pump	17 SEER 9 HSPF	Outdoor Unit $900 Indoor Unit $100
Presque Isle Electric & Gas Cooperative	Ducted or dual fuel heat pump	15 SEER 8.5 HSPF	$1,000
	Mini-split or multi-split heat pump	17 SEER 9 HSPF	Outdoor Unit $900 Indoor Unit $100
Focus on Energy	Ducted or dual fuel heat pump	15+ SEER, 8.5+ HSPF Coil and condenser must be purchased at same time	Downstream $300 offsetting propane or fuel oil $1,000 offsetting electricity or natural gas
	Mini-split or multi-split heat pump	18+ SEER, 9+ HSPF	Midstream $300 offsetting electric or natural gas
ComEd	Ductless mini-split heat pump	17+ SEER and 9.5+ HSPF	Midstream $450
	Air source heat pump	Tier 1: 16+ SEER Tier 2: 18+ SEER	Midstream Tier 1: $400 Tier 2: $500

Mass Save	Ducted ASHP* * Assume any multi-zone heat pump that contains ductless and ducted indoor unit qualifies as ducted ASHP.	9.5+ HSPF and 16+ SEER and 60%+ capacity ratio from 47F to 17F Whole home: weatherization requirements and heat pump must be sized for heating Partial displacement: integrated control from qualified product list must be installed for homes with pre-existing heat type of oil, propane, or natural gas	Downstream Whole home: $10,000 per home Partial displacement: $1,250 per ton up to $10,000
	Ductless ASHP	10+ HSPF and 18+ SEER and 58%+ capacity ratio from 47F to 17F. Whole home: weatherization requirements and heat pump must be sized for heating Partial displacement: integrated control from qualified product list must be installed for homes with pre-existing heat type of oil, propane, or natural gas	Downstream Whole home: $10,000 per home Partial displacement: $1,250 per ton up to $10,000
Efficiency Maine	Ducted and Ductless	1. AHRI-rated HSPF 12.0 or greater for systems with 1 indoor unit 2. AHRI-rated HSPF 10.0 or greater for systems with multiple indoor units or a ducted indoor unit 3. Installed in a 1- to 4-unit residential building located in Maine Installer must be a registered vendor and comply with installation checklist	Downstream Tier 1: $400 – first indoor unit $200 – second indoor unit Loans available
	Ducted and Ductless	1. AHRI-rated HSPF 12.5 or greater 2. Home does not have natural gas utility account 3. Installed in a 1- to 4-unit residential building located in Maine Installer must be a registered vendor and comply with installation checklist	Downstream Tier 2: $800 – first indoor unit $400 – second indoor unit Loans available
	Ducted and Ductless	1. AHRI-rated HSPF 12.5 or greater	Downstream

		2. Owner-occupied single-family home 3. Must be first heat pump at residence 4. Home does not have natural gas utility account 5. Reservation submitted prior to installation 6. Owner receives a LIHEAP benefit, or SNAP, or TANF, or MaineCare, or property meets assessed value limit Installer must be a registered vendor and comply with installation checklist	LMI Tier: $2,000 – first indoor unit Tier 1 or 2 level – second indoor unit Loans available
Efficiency Vermont	Ducted	• Must be new, installed in Vermont, and listed on the Qualifying Products List at the time of purchase. Used, rebuilt, or refurbished equipment is not eligible. • Eligible systems are based on a combination of outdoor unit model number and indoor unit model number or ducting configuration. (Note: Eligibility for centrally ducted systems that utilize the furnace air handler is based on outdoor unit model number only.)	Downstream Up to 2 tons - $1,000 2-4 tons - $1,500 4 tons or more - $2,000 Income-based bonus of $200-$800 depending on utility Loans available
	Ductless	• Must be new, installed in Vermont, and listed on the Qualifying Products List at the time of purchase. Used, rebuilt, or refurbished equipment is not eligible. • Discount is per system (including an outdoor unit and one or more indoor units). • Offer available through participating HVAC distributors.	Midstream (distributors) Up to 2 tons - $350 Over 2 tons - $450 Income-based bonus of $200-$1,000 depending on utility Loans available
	Integrated controls for ductless	• Rebates are for new residential ductless mini-split heat pump installations only (not heat	Downstream Up to $600

		pumps that are already installed) and must be installed in year-round, single-family homes (not second homes). • Equipment must be new. Used, rebuilt, or refurbished equipment is not eligible. • Heat pump and integrated control must be listed on the Qualifying Products List at the time of purchase. • Qualifying controls must communicate a setpoint to the ductless heat pump(s) and central heating system, enable the setpoint to be entered on a single device, prioritize the heat pump or central system based on outdoor temperature, maintain heat pump performance, and connect to the internet. • Central heating system must be oil, propane, or natural gas. Electric resistance and central wood heating systems are not eligible. • Equipment must be installed by an Efficiency Excellence Network contractor. • Customer contribution of $150 is required.	

Table 16 2022 HPWH Rebate Programs

2022 HPWH Rebate Program	Measure	Qualifying criteria	Incentive
Cloverland Electric Cooperative	Heat Pump water heater	UEF 2.0	<50 gallon $700 >50 gallon $1,200
Great Lakes Energy	Heat Pump water heater	UEF 2.0	$1,200
HomeWorks Tri-County Electric Cooperative	Heat Pump water heater	UEF 2.0	$700
Presque Isle Electric & Gas Cooperative	Heat Pump water heater	UEF 2.0	$700
Focus on Energy	Heat Pump water heater	ENERGY STAR	Midstream Rebate starting at $300
ComEd	N/A	N/A	N/A
Mass Save	Heat pump water heater	Uniform Energy Factor (UEF) 3.2+ The new system(s) must be replacing an existing residential electric, propane, natural gas, or oil water heater. Equipment must be installed by a licensed plumber and may be subject to verification inspection.	Midstream instant discount through participating distributors and retailers (Home Depot, Lowes) $750
Efficiency Maine	Heat pump water heater	1. Must be new and installed in Maine 2. ENERGY STAR® certified 3. Unit does not need to be installed by a Residential Registered Vendor unless funded by an Efficiency Maine Home Energy Loan.	5 incentive pathways (midstream and downstream): 1. $549 purchase price after instant discount at Lowe's 2. $549 purchase price after instant discount at Home Depot 3. $599 purchase price after instant discount at Granite Group

			4. Participating distributors offer an instant discount to contractors (amount NA) 5. $850 mail-in rebate Loans available
Efficiency Vermont	Heat pump water heater	• Must be new, installed in Vermont, and listed on the Qualifying Products List at the time of purchase. Used, rebuilt, or refurbished equipment is not eligible. • Customer contribution of $50 to the pre-tax purchase price of each product is required. • Post-purchase rebate is not valid if instant rebate has already been received on the purchase of a qualifying unit through a participating distributor.	Downstream and midstream $300-$600 from Efficiency Vermont or utility Loans available

Table 17 2022 GSHP Rebate Programs

2022 GSHP Rebate Program	Measure	Qualifying criteria	Incentive Delivery
Cloverland Electric Cooperative	Ground source heat pump	≥19 EER	$2,000
	Ground loop for heat pump		$3,500
Great Lakes Energy	Ground source heat pump	≥17 EER	$2,000
	Ground loop for heat pump		$2,500

HomeWorks Tri-County Electric Cooperative	Ground source heat pump	≥19 EER	$1,500
	Ground loop for heat pump		$2,500
Presque Isle Electric & Gas Cooperative	Ground source heat pump	≥19 EER	$1,500
	Ground loop for heat pump		$2,500
Focus on Energy	Ground source heat pump	ENERGY STAR Other qualifications on EER and COP which depend on type	Downstream $750 without natural gas $1,000 with natural gas
ComEd	Ground source heat pump system including loop	ICC certified contractor with geothermal certification enrolled in network	Up to $6,000 per home
	Ground source heat pump Indoor Unit Replacement	Contractor enrolled in network Tier 1: 15+ SEER Tier 2: 17+ SEER Tier 3: 20+ SEER	Downstream Tier 1: $850 Tier 2: $1,000 Tier 3: $1,200
Mass Save	Ground source heat pump	Must be ENERGY STAR certified, qualified, listed with, and certified by AHRI, and meet the program EER and AHRI outdoor unit configuration requirements.	Downstream Whole-home: $15,000 per home Partial displacement: $2,000 per ton*, up to $15,000 *Tons are calculated based on AHRI cooling capacity divided by 12,000 BTUs
Efficiency Maine	Ground source heat pump	• Installed in a 1- to 4-unit residential building located in Maine. Larger buildings, including 5 or more attached condominiums, are not eligible.	Downstream 1/3 of project cost up to $3,000 rebate (note 1-4 units eligible) Loans available

		• Building is principal, year-round residence for occupants, NOT a seasonal, second, or vacation home • Installed in primary living area, not a garage or outbuilding • Lifetime limit of one geothermal rebate per dwelling (A dwelling is a residential unit with a dedicated kitchen, sleeping area, and bathroom.) • Installer must be a residential registered vendor for geothermal systems	
Efficiency Vermont	Ground source heat pump	• Must be new, installed in Vermont, and listed on the Qualifying Products List (or meet 16.1 EER/ 3.1 COP for water-to-water and 17.1 EER/3.6 COP for water-to-air) at the time of purchase. Used, rebuilt, or refurbished equipment is not eligible. • Rebates are for residential systems up to 10 tons and commercial systems up to 50 tons (larger projects	Downstream Up to 10 tons - $2,100/ton 10-20 tons - $1,500/ton 20-50 tons - $1,000 tons$500 income-based bonused Loans available

		may be eligible for custom incentives). • Equipment must be ENERGY STAR® certified (water-to-air and water-to-water heat pumps) or have AHRI certified performance that meets or exceeds the values in the table below under full load conditions. • Only closed-loop applications are eligible (vertical and horizontal loops). • Equipment must be installed by an Efficiency Excellence Network contractor.	

Table 18 2022 Air-Water Heat Pump Rebate Programs

Air-Water Rebate Program	Measure	Qualifying criteria	Incentive Delivery
Cloverland Electric Cooperative	Air-water heat pump	COP of ≥1.7 outdoor air temperature of 5°F and water temperature at 110°F	$2,000
Great Lakes Energy	Air-water heat pump	COP of ≥1.7 outdoor air temperature of 5°F and water temperature at 110°F	$2,000
HomeWorks Tri-County Electric Cooperative	Air-water heat pump	COP of ≥1.7 outdoor air temperature of 5°F and water temperature at 110°F	$2,000
Presque Isle Electric & Gas Cooperative	Air-water heat pump	COP of ≥1.7 outdoor air temperature of 5°F and water temperature at 110°F	$2,000

Focus on Energy	N/A	N/A	N/A
ComEd	N/A	N/A	N/A
Mass Save	Air-water heat pump	Qualified products list with low temperature COP documented. All systems on qualified products list are 1.8 COP or above at 5F with outlet water temperature of 110F.	Downstream $10,000 per home
Efficiency Maine	NA	NA	NA
Efficiency Vermont	Air-to-water heat pump	• Must be new, installed in Vermont, and listed on the Qualifying Products List at the time of purchase. Used, rebuilt, or refurbished equipment is not eligible. • Building must have a water-based distribution system, ideally radiant heating (generally connected to a boiler). • Must be installed by an Efficiency Excellence Network contractor in the air-to-water heat pump group.	Downstream $1,000/ton (max 6 tons) $500 income-based bonus Loans available

APPENDIX C: STAKEHOLDER INTERVIEW LIST

Table 19 Manufacturers Interviewed

Company type	Role of Interviewee	Primary Types of Heat pump offered
Manufacturer	President	Add on Ground Source Heat Pump
Manufacturer	Manufacturer's Rep	Air to Water
Manufacturer	Manufacturer's Rep	Air to Water
Manufacturer	Regional Sales Manager Director of Market Development	Ground Source Heat Pump
Manufacturer	Territory Manager	Ground Source Heat Pump, Air to Water
Manufacturer	Business Development Manager Specialty Products	HPWH
Manufacturer	Business Development Manager	HPWH
Manufacturer	Plumbing Support Manager, Region Sales Manager – Utilities	HPWH
Manufacturer	VP of Marketing	Mini Splits, Central All Electric ASHP
Manufacturer	Senior Business Development Manager Utilities, Sr Account Manager, Senior manager Residential Channel Sales	Mini Splits, Central All Electric ASHP, Air to Water
Manufacturer	Manufacturers Rep	Mini Splits, Central ASHP
Manufacturer	Regulatory Affairs Manager, Utility Rebates Program Manager, Midwest Regional Sales Manager	Mini Splits, Central ASHP, GSHP
Manufacturer	Sr. Manager, Utilities & Electrification, Residential Regional Manager	Mini Splits, Central ASHP, HPWH

Table 20 Distributors Interviewed

Company type	Role of Interviewee	Primary Brands	Primary Types of Heat pump offered	States Regions
Distributor	VP of Sales and Inside Sales Associate	Armstrong Air, American, Comfort Aire, LG	Central ASHP, GSHP, Mini-Split, HPWH	MI
Distributor	VP, product Manager, Lead technical support	Bryant (Payne), Midea, AO Smith	Mini Splits, Central ASHP, limited GSHP	Western UP of MI, MN, WI, ND
Distributor	Product Manager	Bosch, Bryant (Payne), Air Quest, Midea, State	Central ASHP, GSHP, Mini-Split, HPWH	MI
Distributor	Director of Sales and Sales Manager	Bradford White, Carrier (Payne), Midea	Central ASHP, GSHP, Mini-Split, HPWH	MI, OH
Distributor	Project Estimator	Ruud, Luxaire, Fujitsu	Central ASHP, GSHP, Mini-Split, HPWH	IA, MI, MN, MT, ND, SD, WI
Distributor	Director of HVAC Sales & Inside Sales	Bosch, Durastar, Goodman, Fujitsu, Bradford White	Central ASHP, Mini-Split, HPWH	MI
Retailer	Senior Manager, Utility & Government Rebates	Rheem	HPWH and DIY mini split	All 50 states
Distributor	Sales Manager	AO Smith, Bosch, Fujitsu, Heil, Goodman, Tetco	Central ASHP, GSHP, Mini-Split, HPWH	MI and IN
Distributor	Director of HVAC Sales	Rheem, LG, Mitsubishi	Central ASHP, Mini-Split, HPWH	MI and OH

Table 21 Trade & Community Schools Interviewed

Type of School	Region	Interviewee Role	Heat Pump Takeaways
Community College	Upper Peninsula Central MI	Admissions Representative	Class paused due to low enrollment
Community College	Western MI Central MI	Lead HVAC instructor	Fully enrolled with a waiting list. Needs lab space, All types of heat pump tech are in Lab for hands-on experience

Trade School	Eastern MI Southern MI	President	Fully enrolled, needs funding for additional lab space and low-income enrollment. ASHPs (Unitary and mini-split focus)

Table 22 Contractors Interviewed

Company type	Role of Interviewee	Primary Brands	Primary Types of Heat pump offered	City
Contractor	Owner	Daikin, Mitsubishi	Mini Split	Houghton
Contractor	Owner & Office Manager	Bryant	Central ASHP, GSHP, Mini-Split, HPWH	Kalamazoo
Contractor	Vice President of Sales	Fujistu, Lennox	Central ASHP, GSHP, Mini-Split	Portage, Grand Rapids, Three Rivers
Contractor	Owner	American Standard, Mitsubishi	Central ASHP, Mini-Split, HPWH	Escanaba
Contractor	Project Estimator	Mitsubishi, Hydron Module	Mini Split, GSHP	Hancock
Contractor	Owner	American Standard, Rheem, Mitsubishi	Central ASHP, Mini-Split	Dearborn
Contractor	Owner	Mitsubishi, Trane	Mini Split, Central ASHP	Marquette
Contractor	Lead Estimators	Bryant, Rheem, Mitsubishi, Enertech	Central ASHP, GSHP, Mini-Split, HPWH	Traverse City
Contractor	Owner	GeoComfort, Fujitsu	GSHP, Mini-Split	Yale
Contractor	Owner & Marketing Manager	Lennox, Daikin, Mitsubishi, WaterFurnace	Central ASHP, GSHP, Mini-Split, HPWH	Dexter
Contractor	Owner & Lead Estimator	Bradford White, Carrier, Fujitsu, WaterFurnace	Central ASHP, GSHP, Mini-Split, HPWH	Indian River
Contractor	President	Bryant	Not yet offering heat pumps	Commerce Twp
Contractor	Owner	Fujitsu	Mini Splits	Central Lake
Contractor	General Manager	Trane, Mitsubishi	Central ASHP, Mini-Split	Gaylord
Contractor	General Manager	Trane, Mitsubishi	Central ASHP, Mini-Split	Gaylord

Contractor	Lead Estimators	American Standard, Bradford White, Mitsubishi, WaterFurnace	Central ASHP, GSHP, Mini-Split, HPWH	Alanson
Contractor	Owner	Armstrong Air	Central ASHP	Center Line
Contractor	Owner	Bradford White, Enertech, Mitsubishi, Rheem	GSHP, Air to Water, HPWH	Whitmore Lake
Contractor	Owner	Bryant	Mini Splits, Central ASHP	Howell